



No.

REPUBLIC OF CUBA
MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT IN HAVANA CITY
PROVINCIAL DIRECTION OF COMMUNAL SERVICES

**THE STUDY
ON
INTEGRATED MANAGEMENT PLAN
OF
MUNICIPAL SOLID WASTE
IN HAVANA CITY
- REPUBLIC OF CUBA -**

**Final Report
《 Volume II : Main Report 》**



MARCH, 2007

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.

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LIST OF VOLUMES

Volume I : Executive Summary

Volume II : Main Report

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PREFACE

In response to a request from the Government of the Republic of Cuba, the Government of Japan decided to conduct “The Study on Integrated Management Plan of Municipal Solid Waste in Havana City” and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected a study team comprised of experts from NIPPON KOEI CO., LTD. and PACIFIC CONSULTANTS INTERNATIONAL and dispatched the team between January 2004 and January 2006. In addition, JICA set up an advisory committee headed by Dr. Mitsuo Yoshida, Senior Advisor, Institute for International Cooperation, JICA, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of Cuba and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Cuba for their close cooperation extended to the study.

March 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

March 2007

Mr. Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit the final report of “The Study on Integrated Management Plan of Municipal Solid Waste in Havana City”.

Efforts for the appropriate collection, transportation, and disposal of solid waste generated by the general populace of Havana have been taken to secure public health. However, important aspects of solid waste management, such as the maintenance and replacement of existing waste collection/transportation equipment and operation of landfills, have become more difficult due to the serious economic conditions experienced since the collapse of the Soviet Union. The capability of the authorities concerned has not kept up with the increasing difficulty in preventing environmental pollution from inappropriate solid waste management. As a result, the living environment in the Havana region has been steadily deteriorating.

In order to tackle these problems, the aim of the Study was to formulate the master plan for Havana City with an outlook to the year 2015 and to conduct the feasibility study for the prioritized project. The implementation and verification of pilot projects was also an integral component of the study process. The Study also undertook capacity development of the Cuban counterparts by jointly conducting many of the tasks of the Study to improve the capability of the responsible agencies for solid waste management.

We wish to express our sincere appreciation to the officials of JICA, the JICA Advisory Committee, the Ministry of Foreign Affairs, the Ministry of Environment, the Embassy of Japan for Cuba, and JICA Expert for Coordination in Cuba for their continuous support throughout the Study. Also, we would like to express our great appreciation to the Government of the Republic of Cuba, especially the counterparts for their active participation in the Study.

Finally, we hope that the outputs of the Study will contribute greatly to improve solid waste management in Havana City and to foster a long lasting partnership and friendship between the two nations of Cuba and Japan.

Yours faithfully,

JICA Study Team

Main Points of the Study

The Study consisted of: (1) the formulation of the Master Plan (M/P) for Municipal Solid Waste Management (MSWM) in Havana City with an outlook to the year 2015; (2) a pilot project (PLP) to test the practicability of projects suggested in the M/P; (3) a feasibility study (F/S) of the highest priority project included in the M/P; and (4) capacity development for Cuban counterpart staff with responsibility for solid waste management.

The Master Plan:

1. The M/P promulgates the following projects to upgrade the operational efficiency and environmental performance of solid waste management in Havana:
 - (1) Recycling: Recyclables to be recovered from the segregated waste at two new recycling centers (New Guanabacoa and Calle 100)
 - (2) Community composting: To be achieved with two new composting plants (New Guanabacoa and Calle 100) using segregated kitchen waste
 - (3) Home composting: To be introduced to households in eight sub-urban municipalities and gradually to expand the number of participating households at least until the year 2015
 - (4) Segregated collection: Initially to be introduced to two urban municipalities and later to seven urban municipalities, including procurement of collection vehicles and waste bins
 - (5) New landfills: Three new environment-friendly landfills to be constructed (New Guanabacoa for the eastern part of the City, and Calle 100 Extension and New Site 1 for the western part) and heavy equipment to be procured for their operation
 - (6) Closure of landfills: 11 existing landfills to be closed using environmentally appropriate measures. These are: the nine special period landfills, the existing Guanabacoa landfill, and the existing Calle 100 landfill and its extension
 - (7) Maintenance workshops: Equipment and tools to be procured to reinforce the functional capacity of the existing repair and maintenance workshops
2. When the above-mentioned projects are implemented, environmental mitigation measures and environmental monitoring plans specified in the IEE conducted during

the Study will be adopted. Similarly, social issues will be considered and awareness-raising will be carried out as an integral part of the implementation of each project proposed in the M/P.

3. The proposed projects will be implemented during the M/P period of 2007 to 2015. The attached figure shows the components and expected schedule of the proposed projects and the relevant supporting activities.
4. The estimated cost of the projects is US\$96.7 million in foreign currency (FC) and CUP138.4 million in local currency (LC) at 2005 prices. The cost is comprised of the following breakdown:

	<u>FC (US\$ million)</u>	<u>LC (CUP million)</u>
Capital cost	81.9	40.0
O/M cost for 9 years	14.8	98.4
Total	96.7	138.4

5. Within the economic analysis, four items were considered to derive economic benefit, and economic costs and benefits were calculated for foreign and local currency portions separately. The results indicate that the projects are not economically viable with respect to the foreign currency portion. However, due to the difficulty in placing a monetary value on the most important benefits, i.e., improving the hygiene and living environment of the city, the net benefit for input to a full economic evaluation was not assessed. In this kind of public service project, economic viability should not be regarded as a critical factor since the City is obliged to provide the services to a sufficient standard to safeguard public health and provide a hygienic living environment.
6. In reference to financial aspects of solid waste management, the M/P would not result in the operating agency becoming financially self-reliant in regard to operation and maintenance (O/M) work. For O/M to be sustainable, the government would be required to absorb the depreciation cost of facilities and equipment under the state account (no charge to the operating agency's account) and subsidize the MSWM by meeting the shortfall in revenue until such time as the DPSC is authorized to collect full fees from the designated recipients.
7. The M/P includes a proposal to restructure the responsibilities of the existing organizations, DPSC/UPPH and DMSCs, to act exclusively as regulators/supervisors and new Auroras to act as service providers. Six new Auroras are proposed, three for waste collection (one each covering the east, central and western parts of the City), one for landfill operation, one for managing and leasing equipment to the other Auroras, and one to serve as a holding company to manage the other five subordinate companies.

Pilot Project:

8. PLP was implemented as part of the M/P Study consisting of pilot operations for: (i) segregated waste discharge and collection, (ii) community composting, (iii) home composting, and (iv) weighing collected waste. In addition, landfill operations involving daily soil covering were conducted as a program for capacity development of counterpart personnel (C/P) and the present operating agencies (UPPH and DMSC).
 9. The major lessons learnt from the PLP were as follows:
 - (1) Segregated waste discharge and collection: Segregated discharge by residents was not always satisfactory in the initial period, but subsequent intensification of awareness-raising activities improved the residents' performance to an acceptable level. After the period of intense awareness-raising, the level of segregation soon declined again. This fact indicates the necessity of continuous awareness-raising for sustainable segregated discharge collection. In addition, the PLP highlighted how important it is for decision makers to understand the importance of awareness-raising and the provision of a reliable waste collection system with suitable equipment.
 - (2) Community composting: The trial operation in the PLP was of limited success due to the improper segregation of kitchen waste and a lack of experienced technical support. The quality of compost production could not be fully assured, and hence the requirements for successful community composting need to be further examined and confirmed through a new pilot project at some time in the future.
 - (3) Home composting: Most of the residents participating in the PLP were willing to conduct home composting, but some (11 out of 40) were not very active. The compost was thought to be of a quality acceptable for use in household gardening and farming during the pilot project period with monitoring and follow-up by the C/Ps and Study Team. After this period, however, some households did not continue home composting. Therefore, a more functional community-based approach should be taken so that home composting can take root.
 - (4) Waste weighing by truck scale: Staff dispatched from UPPH and DMSCs were able to conduct the work properly. The work is within
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- the capability of present staff, provided that adequate training is given.
- (5) Landfill operation: Waste disposal by the cell method involving soil covering increased the operation of equipment and associated fuel consumption. Adequate planning of equipment operation, e.g., use of the right type and number of equipment, planning of orderly operation sequence, etc., is essential to minimize the increment of costs.

Feasibility Study:

10. F/S was conducted for the highest priority project, the procurement of equipment urgently required for the current operation of MSWM. The equipment listed for procurement are 12 collection vehicles (18 m³ compactor trucks), 27 units of heavy equipment (9 bulldozers, 6 dump trucks, 3 tank lorries, 4 power shovels, 2 shovel loaders, 2 wheel loaders, and 1 tow truck), 62 items of equipment and tools for the vehicle maintenance workshops, and 28 items of equipment and tools and two mobile workshops for the heavy-equipment maintenance workshops. The total procurement cost is estimated at US\$13.68 million in foreign currency and CUP15.31 million in local currency at 2005 prices.
11. In regard to financial considerations, the operating agency will be financially sustainable for the O/M of equipment on the condition that the government provides the support described in Para. 6 above.

Capacity Development:

12. One of the objectives of the Study was to undertake capacity development of C/Ps assigned to the Study. The capacity development was conducted by means of (i) lectures, (ii) on-the-job training, (iii) participation in workshops and meetings with the communities, and (iv) training in Japan.
13. The attainment of capacity development was evaluated in the middle and at the end of the Study. The evaluation showed that the C/Ps achieved a fair degree of attainment (excellent to fair varying by C/P) of knowledge on and ability for MSWM and incentives for continuing to contribute to this work in the future.

The Master Plan - Proposed Implementation Schedule

Description	Year											Remarks
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Proposed Project:												
1 Collection and Transportation												
1.1	Revision of Collection System in Existing Horse-Driven Cart											
	(1) Planning of revised collection system											
	(2) Procurement of equipment and materials											
1.2	Review and Continuous Updating of Collection System											
	(1) Continuous review and updating of collection frequency and bin installation											
	(2) Procurement of steel bins for replacing plastic bins											
1.3	Introduction of Segregated Collection											
	(1) Awareness-raising program											Initially for 2 municipalities and then 5 municipalities
	(2) Introduction in 2 municipalities											
	(3) Introduction in 5 municipalities											
	(4) Vehicle procurement to meet the segregated collection											
1.4	Monitoring and Improvement of Activities											
2 Landfill												
2.1	Construction of New Landfills											
	(1) New Guanabacoa Landfill											
	(i) EIA study and approval											EIA Study has been done
	(ii) Design and contract procurement											
	(iii) Construction											Commence operation in partial area in 2007
	(2) New Landfill 1											
	(i) EIA study and approval											
	(ii) Land acquisition and resettlement											Site selection by 2007
	(iii) Design and contract procurement											
	(iv) Construction											
	(3) Expansion of Calle 100											
	(i) EIA study and approval											
	(ii) Design and contract procurement											
	(iii) Construction											
2.2	Closure of Existing Landfills											
	(1) Special Period Landfill											
	(i) EIA and monitoring plan											
	(ii) Design and contract procurement											
	(iii) Construction											
	(2) Existing Guanabacoa Landfill											
	(i) EIA and monitoring plan											
	(ii) Design and contract procurement											
	(iii) Construction											
	(3) Existing Calle 100 Landfill											
	(i) EIA and monitoring plan											
	(ii) Design and contract procurement											
	(iii) Construction											80 ha 24 ha
3 Reinforcement of Maintenance Workshops												
3.1	Procurement of Equipment and Tools											
3.2	Training of Staff and Workers											
4 Recycling and Composting												
4.1	Recycling Centers											
	(1) Planning, design and contract procurement											
	(2) Construction											Calle 100 New Guanabacoa
4.2	Community Composting											
	(1) Continuation of trial operation for confirmation of quality											
	(2) EIA study and approval											
	(3) Design and contract procurement											
	(4) Construction											New Guanabacoa Calle 100
4.3	Home Composting											
	(1) Awareness-raising program											
	(2) Procurement of compost bins for delivery to households											Total: 43,000 units
	(3) Introduction in 8 municipalities											Area gradually expands
	(4) Monitoring and improvement of activities											
Supporting Activities:												
5 Regulations and Standards												
5.1	Legislation											
	(1) Preparation of overall regulations for MSWM											
	(2) Revision of EIA regulations to include social aspects											
	(3) Legislation to authorize DPSC to sell recyclables to free markets											
5.2	Standards and Guidelines											
	(1) Guidelines for landfill construction and operation											
	(2) Standards for leachate											
	(3) Standards for composting products											
6 Organizational and Institutional Aspects												
6.1	Establishment of a Task Force for Supporting Awareness-Raising											
6.2	Reformation of MSWM Organizations											
6.3	Mobilization of New Aurora Enterprise											
6.4	Collection of Fees from Recipients											

Legend:  Continuous Activity  Intermittent activity  Commencement of Operation

Volume II : Main Report

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Abbreviations

<Organizations>

AMA	Environment Agency
CAM	Municipal Administration Council
CAP	Provincial Administration Council
CDR	Committee for Defense of Revolution
CITMA	Ministry of Science, Technology and Environment
CPC	Communist Party of Cuba
DMSC	Municipal Direction of Communal Services
DPEP	Provincial Direction of Economy and Planning
DPFP	Provincial Direction of Finance and Prices
DPPF	Provincial Direction of Physical Planning
DPSC	Provincial Direction of Communal Services
DPTSC	Department of Territorial Planning and Community Services
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
ERMP	Enterprise for the Recovery of Raw Materials
FMC	Federation of Cuban Women
GRC	Government of the Republic of Cuba
GOJ	Government of Japan
IMF	International Monetary Fund
MI	Metallurgic Industry
INRH	Institution of Water Resources
JICA	Japan International Cooperation Agency
LARE	Residues Analysis Laboratory
MEP	Ministry of Economy and Planning
MFP	Ministry of Finance and Prices
MINAGRI	Ministry of Agriculture
MINBAS	Ministry of Energy Utility Services
MINSAP	Ministry of Public Health
MINVEC	Ministry of Foreign Investment and Economic Cooperation
MRF	Future Recovery Movement (MRF: student activity for material recovery)
PAHO	Pan-American Health Organization
PNAT	National Office of Tax Administration
PPI	Physical Planning Institute
SIME	Metallurgic Industry
UERMP	Association of Enterprises for the Recovery of Raw Materials
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UPPH	Provincial Unit of Hygiene
WHO	World Health Organization
<Others>	
BOD	Biochemical Oxygen Demand
CAR	Cartagena Convention
C/T	Compactor Truck
COD	Chemical Oxygen Demand
C/P	The Cuban Counterpart
CBP	Capacity Building Program
CDP	Capacity Development Program
CZ	Communal Zones
DF/R	Draft Final Report
DO	Dissolved Oxygen
D/T	Dump Truck
DF/R	Draft Final Report
EC	Electric Conductivity
EI	Estimation of Environmental Impact
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EPEA	Provincial Strategy for Environmental Education
FC	Foreign Currency
FCC	Freely Convertible Currency
F/R	Final Report
F/S	Feasibility Study
FIRR	Financial Internal Rate of Return
GEF	Global Environmental Fund
GDP	Gross Domestic Product
GNP	Gross National Product
H/C	Horse-driven Cart
HDPE	High Density Polyethylene
IC/R	Inception Report
IEE	Initial Environmental Examination
IT/R	Interim Report
LC	Local Currency
MLC	Monteda Libremente Convertible (Freely Convertible Currency)
M/M	Minutes of Meeting
M/P	Master Plan
MSW	Municipal Solid Waste

MSWM	Municipal Solid Waste Management
MUV	Manufacturing Unit Value
NC	Norma Cubanas (National Standard)
NGO	Non-Governmental Organization
NPV	Net Present Value
O/M	Operation and Maintenance
ODA	Official Development Assistance
OJT	On the Job Training
pH	Hydrogen Ion Concentration
PCM	Project Cycle Management
PDM	Project Design Matrix
PLP	Pilot Project
PPP	Polluter Pays Principle
PR/R	Progress Report
SC	Steering Committee
SPL	Special Period Landfill
SS	Suspended Solids
S/W	Scope of Works
SWM	Solid Waste Management
T/C	Tractor-driven Cart
TDS	Total Dissolved Solids
WG	Working Group
WS	Workshop
WTP	Willingness to Pay
3R	Reduce, Reuse, and Recycle

Measurement Units

Area

cm² = square-centimeters
m² = square-meters
km² = square-kilometers
ha = hectares (10,000m²)

Volume

cm³ = cubic-centimeters
m³ = cubic-meters
lit = liter

Length

mm = millimeters
cm = centimeters
m = meters
km = kilometers

Weight

gr = grams
kg = kilograms
tons = metric tonnes

Currency

US\$ = United States Dollar
US\$1.00 = J¥110
(September, 2004)
J¥ = Japanese Yen
CUC = Cuban Convertible Peso
CUP = Cuban Local Peso

Time

sec = seconds
min = minutes
hr = hours

PART 1 INTRODUCTION OF THE STUDY

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Havana City has an area of 727 km² and population of 2.2 million. It is the capital of the Republic of Cuba and is the center of economic activity in the country. The City is known as a tourist spot internationally and the area known as the “old city” is designated as a world heritage area. Administratively, Havana City consists of 15 municipalities comprised of 105 districts.

Economic difficulties since the collapse of the Soviet Union have had an adverse impact on solid waste management in Havana, resulting in significant deterioration in the performance of waste collection owing mainly to deterioration in the condition of collection vehicles and mechanical equipment.

Collection of municipal solid waste (MSW) in the City is carried out by compactor truck (C/T), dump truck (D/T), tractor-driven cart (T/C) and horse-driven cart (H/C), varying by area. As stated above, these vehicles are poorly maintained.

Fourteen final disposal sites for solid waste operated in Havana City at various scales. None employ pollution control measures such as leachate treatment facilities or soil covering operations. All sites appear to be having adverse impacts on the surrounding environment.

Of the 14 sites, four are relatively large-scale sites collecting waste from wide areas of the City. Of the four large sites, two are almost filled with waste and require closure within a few years. The other 10 small-scale sites, called ‘special period landfill’, were constructed after the economic crisis with the intent of being used as temporary facilities; therefore, they were located closer to the collection areas to reduce transportation cost. Nine of the 10 sites will also be closed by the end of 2006 due to environmental problems they are causing for adjacent areas.

At present, various organizations are involved in municipal solid waste management (MSWM) in the City at various operational levels. UPPH (Provincial Unit of Hygiene) under DPSC (Provincial Direction of Communal Services) is in charge of MSWM at the City level, and DMSC (Municipal Direction of Communal Services) at the municipality level. In addition, four public corporations, called ‘Aurora’, are also involved in solid waste collection.

Although the City and organizations concerned are making efforts for the improvement of MSWM, a long-term management plan has not yet been formulated.

In response to the official request of the Government of the Republic of Cuba based on the above mentioned background, the Government of Japan decided to conduct the Study on Integrated Management of Municipal Solid Waste in Havana City.

Accordingly, the Japan International Cooperation Agency, official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, dispatched the preparatory mission to Cuba and the Scope of Work for the Study was discussed, agreed to and signed by both the Cuban side and the Japanese side on the 7th of August 2003.

1.2 Objectives of the Study

The objectives of this Study, the Study on the Integrated Management Plan of Municipal Solid Waste in Havana City, agreed to in the Scope of Work, were as follows:

- 1) To formulate the master plan (M/P) for integrated management of MSW for Havana City.
- 2) To conduct the feasibility study (F/S) on priority project(s) which will be selected from the master plan including implementation of pilot projects.
- 3) To pursue technology transfer to the counterpart personnel in the course of the Study.

1.3 Scope of the Study

The scope of the Study was set as follows:

- a) The target year for the M/P is set as 2015. The long term vision of the solid waste management shall be prepared for 2025.
- b) The type of solid waste to be studied is the MSW generated in Havana City. With respect to medical waste and industrial solid waste, the Study was to be limited to examining current conditions and problems with collection, disposal, and the operation and maintenance capacity of relevant organizations; recommendations relating to these aspects were to be made as required.
- c) Cover all aspects of MSWM, including collection, transportation, and disposal of all types of municipal solid waste, recycling, institutional and organizational frameworks, awareness-raising, social and environmental considerations, and project evaluation.

- d) Components of the Study include implementing of pilot projects, workshops and awareness study.

The scope of the Study and the associated minutes of meeting which were agreed to between Havana City and the JICA Preparatory Mission on August 7, 2004, are attached at the end of this report as Appendixes 2 and 3, respectively.

1.4 Study Area

The Study Area agreed in the Scope of Works covers all 15 municipalities of Havana City. The Study Area has a total area of 727 km² and population of approximately 2.2 million. A map of the Study area is shown in Figure 1.4.1.

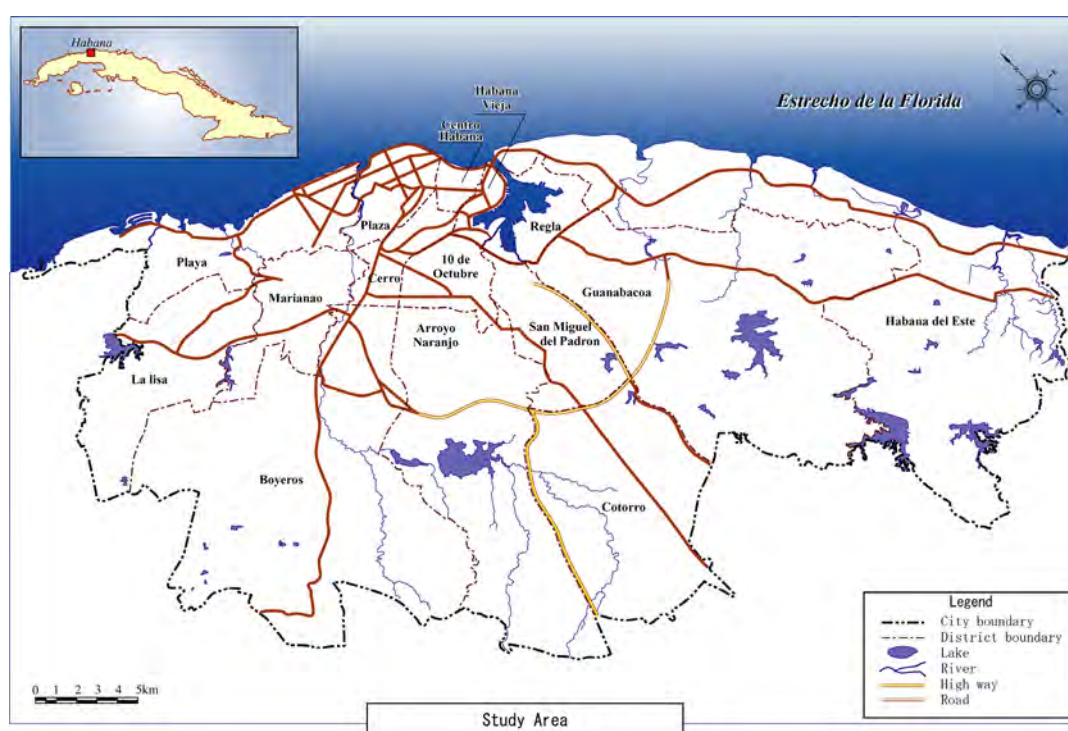


Figure 1.4.1 Map of the Study Area¹

1.5 Study Period

The total work period of the Study was originally scheduled to be 21 months from February 2004 to October 2005, but was extended to be 38 months until March 2007 owing to extra time being required for finalization of the Final Report (F/R).

Table 1.5.1 shows the reports of the Study.

¹ Tables and Figures which do not mention source were prepared by the Study Team. This footnote is applicable to all other tables and Figures shown hereinafter.

This F/R compiles all the results of the investigation and studies.

Table 1.5.1 Reports of the Study

Report Submitted	Major Contents of the Reports	Month Submitted
Inception Report (IC/R)	- Method and approach to the Study - Study schedule - Plan of operation - Staffing and organization - Undertakings of the Government of Cuba	February 2004
Progress Report (1) (PR/R(1))	- Results of analysis on the current situation - Long-term vision on solid waste management systems - Outline of the Master Plan - Outline of candidate Pilot Projects - Preliminary selection and outline of the Pilot Project	July 2004
Interim Report (IT/R)	- First Draft of the Master Plan - Selection of priority project for the F/S - Selection of the Pilot Project	November 2004
Progress Report (2) (PR/R(2))	- the Draft Master Plan - Interim results of other study activities	March 2005
Draft Final Report (DF/R)	- the Final Master Plan and results of all items of the survey and study including the F/S	September 2005
Final Report (F/R)	- All the Study outputs after incorporating the comments on the DF/R by the Cuban side	March 2007

1.6 Cuban Counterparts

The counterparts to the Study are, in principle, personnel from the Ministry of Science, Technology and Environment in Havana City (CITMA – Havana) and the Provincial Direction of Communal Services (DPSC).

1.7 Final Report

This F/R is hereby submitted as the final product of the Study.

The Report presents (i) the M/P for municipal solid waste management in Havana City toward 2015, (ii) the results and findings from pilot projects, (iii) the feasibility study on the priority projects, and (iv) the results of capacity development conducted during the course of the Study.

The Final Report consists of the following 4 volumes:

- Volume I Executive Summary
- Volume II Main Report (this volume)
- Volume III Supporting Report
- Volume IV Data Book

All reports were written in English. Japanese and Spanish versions of the Executive Summary were prepared and a Spanish version of the Main Report was prepared.

Before preparation of this F/R, the DF/R was explained and discussed at the Steering Committee (SC) meetings held in September 2005. An additional explanation of the revised DF/R was also conducted in January 2006. The F/R was finalized incorporating the comments from the Committee and other relevant agencies.

CHAPTER 2 CURRENT CONDITIONS OF THE STUDY AREA

2.1 Outline of Study Area

The Study Area is Havana City, the capital of the Republic of Cuba. Havana City has a population of 2.2 million and is divided into 15 municipalities. The 15 municipalities are further divided into 105 districts.

The overall area of Havana City is 727 km² with generally flat relief. Hills are mostly lower than several hundred meters in elevation. The northern part of the City is urbanized, while the southern sub-urban areas are still underdeveloped, with significant areas of natural vegetation remaining.

2.2 Natural Environment

2.2.1 Climate

The climate of Havana City is characterized from the climatic data of Casablanca and Santiago de las Vegas meteorological stations.

The maximum temperature in 2002 was 29.4 °C at Casablanca and 30.5 °C at Santiago de las Vegas, while the minimum temperature was 22.3 °C and 20.5 °C, respectively. The maximum and minimum temperatures recorded at Casablanca during the period from 1909 to 2002 were 35.8 °C and 8.5 °C, respectively.

The annual rainfall in 2002 was 1,111.3 mm. During the rainy season (from May to October), monthly rainfall varied from 73.0 mm to 166.7 mm and the rainfall during the rainy season represented 62% of the annual total. In the rainy season, hurricanes often hit Havana City, with the heavier storms occurring in September and October.

Relative humidity varies seasonally in accordance with the rainfall pattern. The highest monthly means, around 80%, occur between June and November while the minimum are recorded from January to April at around 70%.

2.2.2 Hydrology

The area of Havana City is divided into four drainage basins; Almendas Vento, East Basin, West Basin and Havana Bay Basin. About 47% of the drinking water consumed by the population in Havana City comes from the basin of Vento by extracting from Ejercito Rebelde dam, a water storage dam in the Vento Basin. The water is also used extensively for agriculture, especially in Havana City

province. The basin area is 402.02 km². More than half a million people live in this basin.

Most of the main rivers in Havana City flow from south-west to north-east and finally discharge into the sea. The lengths of the main rivers are shown in Table 2.2.1.

Table 2.2.1 Main Rivers in Havana City

River	Length (km)
Almendares	46.8
Jaimanitas	11.8
Quibu	11.7
Luyano	10.4
Martin Perez	6.4
Cojimar	22.0
Guanabo	22.1
Itabo	17.0
Bacuranao	21.7

Source: Territorial Office of Statistics of Havana City

2.3 Socio-economic Conditions and Administrative Divisions

2.3.1 Socio-economic Conditions

(1) Population

The population of Cuba at the end of 2001 was approximately 11.2 million. The average annual population growth for the last decade (1992 to 2001) was less than 0.4%, which is well below the Latin American average. In 2001, 25% of the Cuban population was 50 years old and over, with 10% being 65 and over. The urban population in Cuba accounts for 75% of the total.

The Province of Havana City had a total population of approximately 2.2 million in mid-2002, representing about 20% of Cuba's population and 26% of its total urban population. The population distribution by municipality is as shown in Table 2.3.1.

The Municipality of Centro Habana is literally located at the center of the province and has the highest population density of 43,047 persons/km². The population of Havana City is older than the rest of the country, with 29% of the population being older than 50 years, and 12% being older than 65 years.

Table 2.3.1 Population of 15 Municipalities in Havana City

Municipality	Total	Male	Female	Population Density (Person/km ²)
Playa	181,256	85,048	96,208	5,011
Plaza de la Revolución	171,528	78,357	93,171	14,511
Centro Habana	149,476	69,542	79,934	43,047
La Habana Vieja	94,635	44,696	49,939	21,046
Regla	42,391	20,347	22,044	4,624
La Habana del Este	185,543	89,853	95,690	1,280
Guanabacoa	106,292	51,417	54,875	834
San Miguel del Padron	153,956	74,062	79,894	5,999
Diez de Octubre	227,501	105,712	121,789	18,734
Cerro	134,778	62,935	71,843	13,149
Marianao	137,838	65,444	72,394	6,464
La Lisa	127,843	61,978	65,865	3,408
Boyeros	188,881	91,820	97,061	1,407
Arroyo Naranjo	199,542	96,526	103,016	2,402
Cotorro	74,453	36,563	37,890	1,134
Total Ciudad de Havana	2,175,913	1,034,300	1,141,613	2,992

Note: Data as of 30 June 2002

Source: Anuario Estadístico de Ciudad de La Habana 2002, Territorial Office of Statistics of Havana City

(2) Economic activities

In the wake of the fall of the Berlin Wall in 1989 and the collapse of the Soviet Union in 1991, Cuba experienced a severe economic depression in the early 1990s. The GDP (gross domestic product) of Cuba diminished by 35% from 1989 to 1993. The Cuban government has undertaken various reforms to stem excess liquidity, increase labor incentives, and alleviate serious shortages of goods and services. The reforms were successful and the GDP picked up again in 1994. The average growth rate from 1997 to 2002 was over 3% as shown in Table 2.3.2.

The composition of Cuba's GDP is presented in Tables 2.3.3.

Table 2.3.2 Historical data of Cuba's GDP

	(Unit: Billion US\$ equivalent)							
Year	1990	1995	1997	1998	1999	2000	2001	2002
GDP	54.1	36.0	40.1	40.2	42.6	45.2	46.6	47.1
Annual increase	n.a	n.a	n.a	2.5%	6.0%	6.0%	3.0%	1.2%

Note: At 1990 price for year 1990, and at constant 1995 prices for years 1995-2002.

n.a.: Not available

Source: "Statistical Yearbook for Latin America and the Caribbean 2003", ECLAC

There was a triple-currency system in Cuba until 2004. Although the legal Cuban currencies were the Cuban local peso (CUP) and Cuban convertible peso (CUC), US dollars were also circulated in normal commerce and transactions. The CUP was used for pricing of goods and services provided in Cuban local materials. The CUC was used for pricing of goods and services for which raw materials were imported. The US dollar was used equally at par in CUC transactions.

Table 2.3.3 Composition of Cuba's GDP

	1997	1998	1999	2000	2001
Total GDP					
At current prices (million Pesos)	23,439	23,777	26,147	28,206	29,402
At constant 1997 prices (million Pesos)	23,439	23,476	24,956	26,482	27,274
Composition by expenditure					
Private consumption	66%	67%	67%	64%	64%
Government consumption	21%	21%	21%	20%	21%
Gross fixed investment	13%	13%	13%	14%	13%
Increase in stocks	3%	1%	0%	1%	1%
Exports of goods and services	16%	17%	18%	19%	18%
Imports of goods and services	-19%	-20%	-19%	-18%	-17%
Total	100%	100%	100%	100%	100%
Composition by sector					
Agriculture	8%	7%	7%	7%	6%
Industry	30%	28%	28%	29%	28%
Mining	2%	1%	1%	2%	2%
Manufacturing	20%	18%	18%	18%	17%
Electricity, gas and water supply	2%	2%	2%	2%	2%
Construction	7%	6%	6%	7%	7%
Services	62%	65%	65%	64%	66%
Commerce, restaurants and hotels	27%	29%	27%	28%	28%
Transport, warehousing and communication	7%	9%	10%	9%	11%
Financial service, real estate, and corporate service	7%	7%	8%	7%	7%
Communal, social and personal services	19%	19%	19%	18%	19%
Import duties	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%

Source: "Statistical Yearbook of Cuba 2001" National Statistics Office

(3) Tourism

The tourism industry has become the most dynamic sector of the economy. The industry has also created demand that has contributed to the revitalization of other sectors of Cuba's economy. The international tourism system in Cuba comprises 44 main entities. Of these, 33 are directly run by the Ministry of Tourism, eight by Gaviota, and three by the Historian's Office.

In 1990, Cuba received 0.34 million foreign tourists, with international tourism revenues totaling US\$243 million equivalent. In 2002, gross revenues totaling about US\$1.8 billion equivalent were generated by the tourism industry. The tourism industry's contribution to Cuba's total foreign revenue rose from 4% in 1990 to 41% in 2001. The biggest proportion of investment in the tourism industry is directed towards hotel construction.

Eight tourism areas, in which 92% of the total number of rooms is concentrated, are Havana City, Varadero, Jardines del Rey, Santa Lucia, Holguin, Santiago de Cuba, the south-central coast (Trinidad-Cienfuegos), and the Los Canarreos Archipelago.

Direct employment in the tourism sector has grown in recent years from 54,000 to 100,000 jobs, while indirect employment rose from 30,000 to close to 200,000.

The change in the number of foreign tourists is presented in Table 2.3.4. Approximately 1 million foreign tourists visited Havana City in 2003, which accounted for 51% of the total visitors to Cuba. There was a drop in 2002 due to the negative impact on global tourism caused by the September 11 terrorist attacks. However, tourist arrivals to Cuba bounced back and exceeded 1.9 million in 2003.

Table 2.3.4 Historical Trend of Number of Foreign Tourists

(Unit: 1,000 persons)

	1997	1998	1999	2000	2001	2002	2003
Tourists to Havana City	649	781	867	951	980	959	974
Tourists to Cuba	1,170	1,416	1,603	1,774	1,775	1,686	1,906
Ratio of Havana City	55%	55%	54%	54%	55%	57%	51%

Source: Havana City Territorial Office of Statistics

2.3.2 Administrative System

Cuba has a centralized political system. The head of state is the President. The highest executive body is the Council of Ministers, which has an Executive Committee comprising the President, the First Vice-President and the Vice Presidents of the Council of Ministers.

Cuba is divided into 15 administrative regions comprising 13 provinces, Havana City, and a special municipality. Each region has a provincial government, which is called the Provincial Administration Council (CAP). There are 169 municipalities under those regions. The Province of Havana City is divided into 15 municipalities: Playa, Plaza de la Revolución, Centro Habana, Habana Vieja, Regla, Habana del Este, Guanabacoa, San Miguel del Padron, Diez de Octubre, Cerro, Marianao, La Lisa, Boyeros, Arroyo Naranjo, and Cotorro.

The municipal government is called the Municipal Administration Council (CAM). An additional bottom tier of local government is the People's Council. Each municipality in Havana City has three to ten People's Councils, totaling 101 within Havana City.

At the state level, the competent authority of community services is the Ministry of Economy and Planning (MEP). Within MEP, the Department of Territorial Planning and Community Services (DPTSC) is charged with community services. Although MEP plans, adjusts and sets the main budgets for all communal services in Cuba, technical coordination is dependent on other ministries with proper capabilities. In the MSWM sector, CITMA assists with technical issues while medical and sanitation issues are addressed by the Ministry of Public Health

(MINSAP). The Ministry of Labor and Social Security sets and controls the number of workers and the wages paid in community services.

At the provincial level, the CAP of Havana City has the DPSC as a competent department for community services. The DPSC is naturally under the direct supervision of the CAP. Furthermore, in the Cuban administrative structure, a department within each CAP is also supervised by its counterpart ministry at the state level. Thus, the DPTSC can be also regarded as a supervisory authority of DPSC at the state level.

2.4 Current Land Use

Havana City has an area of 727 km². The old city area and its fortifications were designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a world heritage in 1982.

In terms of land utilization, 304 km² (41.8%) is currently used for agriculture, while the remaining 422 km² (58.2%) is used for non-agricultural purposes. The data on land utilization in Havana City are summarized in Table 2.4.1.

Table 2.4.1 Land Use in Havana City

Items	Area (km ²)	Ratio (%)
Agricultural Area	304.30	41.8
Non Agricultural Area	422.84	58.2
Residential Area	237.44	32.7
Roads	20.43	2.8
Industrial Area	27.27	3.7
Water resources and related facilities	25.89	3.6
Others	111.81	15.4
Total	727.14	100

Source: Delegation Provincial del MINAGRI, 2002

PART 2 THE MASTER PLAN

CHAPTER 1 FORMULATION OF THE MASTER PLAN

1.1 Joint Formation for Formulation of the Master Plan

One of the objectives of the Study is to formulate the M/P for MSW in Havana City while simultaneously conducting capacity development of the C/Ps through their involvement in the Study.

An expected outcome of the capacity development is that, as mentioned in “Part 5 Capacity Development”, the C/Ps would work out the M/P through their active participation and initiative and develop a sense of ownership of the Study. The C/Ps would also be expected to passively acquire the ability to revise the M/P when and as the need arises in the future with limited assistance from foreign advisers/experts.

To meet these objectives, the M/P was formulated with the following joint formation considering the present capacity of the C/Ps and their busy work circumstances.

- In principle, the C/Ps would formulate the M/P with technical assistance from the Study Team as necessary.
- Technology transfer for the formulation of the M/P was conducted by joint work including on the job training (OJT). Each C/P was paired with an appropriately qualified expert from the Study Team.
- Field surveys to understand the current MSWM conditions and the PLP, which would indicate the conditions for formulation of the M/P, were jointly planned, implemented, and verified through frequent consultation between the C/Ps and the Study Team.
- Ideas for the draft M/P were firstly discussed by the experts of both sides and prepared by the Study Team as a document.
- The draft M/P was then brushed up through a series of discussions involving the C/Ps, the Study Team, and concerned organizations such as CITMA, DMSC, Enterprise for the Recovery of Raw Materials (ERMP), Ministry of Agriculture (MINAGRI), Auroras, Havana Municipality, etc.
- Main points of the projects proposed in the draft M/P was also discussed and confirmed at the SC, then the comments by the Cuban side were fed back to

revise the draft M/P. The memorandums of the discussions at the SC are attached to the Main Report as APPENDIX 3.

- Final draft of the M/P was presented in the DF/R by the Study Team in September 2005. Reflecting the comments on the DF/R by the Cuban side, the main points of the M/P were again discussed and confirmed by both sides in January 2006 and then the M/P was finalized in this F/R.

Therefore, although the reporting has been done by the Study Team, the M/P shown in Chapter 3 was formulated fully based on the intentions of the Cuban side with their active participation to the greatest possible extent.

1.2 Formulation Steps of the Master Plan and Considered Points

The M/P was formulated through the following steps.

- 1st Step: Review of current situation of SWM and problem analysis
- 2nd Step: Setting of future framework and projection of waste quantity and quality in the future
- 3rd Step: Setting of the social economic conditions and long-term vision of SWM towards 2025
- 4th Step: Consideration of SWM strategies towards 2015
- 5th Step: Preparation of the draft M/P
- 6th Step: Preparation of the implementation plan for the PLP and outlining of the draft M/P to residents as background to the PLP
- 7th Step: Implementation of the PLP and review of the draft M/P based on evaluation of the results and lessons learned from the PLP
- 8th Step: Preparation of the DF/R with the final draft M/P and confirmation of its contents
- 9th Step: Formulation of the M/P (finalization)

In following the above steps, the feasibility of the M/P was the most crucial point to be considered. Therefore, the results of the PLPs that would be carried out by the Study were be verified and fed back to the M/P. As shown in Part 3 in detail, however, the results of the PLP could not fully verify the feasibility of the proposed projects in the M/P.

On the other hand, considering that the PLPs were conducted under the limitations

of the Study, it cannot be concluded that the proposed projects should be denied only as a result of the PLP.

Therefore, the C/P and the Study Team consulted and pointed out the issues to be solved for implementation of the projects in the M/P. Those issues are summarized in Chapter 4.

CHAPTER 2 DATA COLLECTION, FIELD STUDIES AND WORKSHOPS

2.1 Data Collection and Preparation

The Study Team, together with the Cuban counterparts (C/Ps), collected data and information necessary for the preparation of the M/P through a series of field surveys. The surveys were conducted according to a pre-arranged schedule agreed in the Inception Report (IC/R) and covered the following:

- Waste quantity and quality survey;
(Main Report Part 1, 2.2.1 and Data Book A1)
- Recycling market survey;
(Main Report Part 1, 2.2.2 and Data Book A2)
- Survey of quantity of MSW hauled to landfills;
(Main Report Part 1, 2.2.3)
- Time and motion survey;
(Main Report Part 1, 2.2.4)
- Water quality survey, and;
(Main Report Part 1, 2.2.5)
- Environmental awareness survey;
(Main Report Part 1, 2.2.6)

In addition to the above, a questionnaire survey of 15 factories and 5 hospitals was conducted to identify their solid waste management systems and the quantity of industrial and hospital wastes being generated from them.

2.2 Field Studies and Surveys

2.2.1 Waste Quantity and Quality Survey

The waste quantity and quality survey revealed the waste generation rate, present situation of waste generation, physical composition of MSW by generation source, and the chemical characteristics of MSW. The findings are discussed below.

(1) Waste quantity and composition survey

The objectives of the waste quantity and composition survey were to identify the quantity and composition of MSW and perform technical transfer to the C/Ps during the survey implementation. During the first survey in the dry season, the C/Ps learned how to manage the survey. In the second survey conducted in the rainy season, the C/Ps had already become familiar with the survey method and

were able to undertake the lead role in the survey instead of the Study Team. The summary of the waste quantity and composition survey is shown in Table 2.2.1.

Table 2.2.1 Outline of Waste Quantity and Composition Survey on MSW

Item	Quantity Survey	Composition Survey
Survey Period	Dry season: 16-21 April 2004 Rainy season: 30 September to 5 October 2004	
Number of days surveyed:	Two weekdays and two weekend days	Two days in each season
Quantity of surveys conducted:	1) Survey of domestic waste: For 9 households each for 5 municipalities; total 45 households 1-1) Old city: 2 municipalities (Plaza, Centro Havana) 1-2) Suburbs: 3 municipalities (Boyeros, Guanabacoa, Marianao) 2) Survey of commercial waste: 2-1) Hotels: 3 2-2) Restaurants: 3 2-3) Offices: 3 3) Survey of wastes hauled to the landfills: 3-1) At 2 provincial landfills: Calle 100 and Guanabacoa 3-1) At 2 special period landfills: Fratanidad and Los Perros	

1) Waste quantity

Tables 2.2.2 and 2.2.3 shows the unit generation rate, which is a basic parameter of waste generation, of domestic and commercial waste as obtained from the survey. The average unit generation rate of domestic waste in five municipalities was 0.7 kg/day/person in the dry season and slightly less, 0.6 kg/day/person, in the rainy season. The average unit generation rates of all three types of commercial waste in the rainy season were either smaller or nearly the same as the same ones in the dry season.

Table 2.2.2 Unit Generation Rate (Domestic Waste)

Municipality	Number of Surveys	Survey Days	Effective Number of Samples	Unit Generation Rate (kg/day/person)			
				Minimum	Average	Maximum	
Dry Season	Centro Havana	9	4	36	0.0	0.7	3.9
	Guanabacoa	9	4	36	0.1	0.6	2.1
	Plaza	9	4	36	0.1	0.7	3.4
	Marianao	9	4	36	0.2	0.9	2.5
	Boyeros	9	4	34	0.1	0.9	4.8
	Average	9	4	36	-	0.7	-
	Total	45	20	178	-	-	-
Rainy season	Centro Havana	9	4	35	0.1	0.6	3.2
	Guanabacoa	9	4	34	0.0	0.4	1.3
	Plaza	9	4	35	0.0	0.7	1.5
	Marianao	9	4	35	0.0	0.7	3.1
	Boyeros	9	4	36	0.1	0.6	1.9
	Average	9	4	35	-	0.6	-
	Total	45	20	176	-	-	-

Note: The value of unit generation rate is rounded to one decimal point.

Table 2.2.3 Unit Generation Rate (Commercial Waste)

Unit: Office: kg/day/employee, Restaurant: kg/day/shop, Hotel: kg/day/room

Season	Type of commerce	Number of Survey	Survey Days	Effective Number of Samples	Unit Generation Rate		
					Minimum	Average	Maximum
Dry Season	Office	3	2	6	0.1	0.3	0.6
	Hotel	3	4	11	0.3	1.2	2.4
	Restaurant	3	4	11	10.0	30.5	40.0
Rainy season	Office	3	2	6	0.0	0.1	0.4
	Hotel	2	4	7	0.5	0.8	1.3
	Restaurant	2	4	8	14.4	23.8	40.3

Note: The value of each unit generation rate is rounded to one decimal digit.

The daily number of trips for transportation of MSW to landfills was also counted during these survey days and the result is shown in Table 2.2.4. Calle100 landfill received about 150~370 deliveries in the dry season and about 190~450 in the rainy season. The number of daily trips to Guanabacoa landfill was about 40~130 in the dry season and about 20~78 in the rainy season. The waste transported to special period landfills (SPLs) was much less than those to the provincial landfills, namely Calle 100 and Guanabacoa.

Table 2.2.4 Daily Transportation of Wastes to Landfills

Unit: Number of trips of truck

			Week day	Saturday	Sunday
Provincial landfill	Calle 100	Dry	357 - 369	315	149
		Rainy	348 - 455	189	No data
	Guanabacoa	Dry	118 - 127	101	40
		Rainy	146	78	42
Special period landfill	Los perros	Dry	42	35	29
		Rainy	43 - 52	20	9
	Fratanidad	Dry	32 - 59	39	35
		Rainy	38	40	20

Note: Dry: Dry season, Rainy: Rainy season

2) Waste composition

Table 2.2.5 shows the results of the waste composition survey, covering both domestic and commercial wastes. Regarding domestic waste, paper and glass each averaged 10% and kitchen wastes averaged 61% over the two seasons, the total of which take a major portion of domestic wastes; at about 80%. The proportion of paper in commercial waste was more than 20%, considerably larger than in domestic waste. The proportion of aluminum was 11% from hotels and 6% from restaurants averaged over the two seasons, which was higher than that of domestic waste. This suggests these types of commerce may potentially be a good source of aluminum and paper items for recycling.

Table 2.2.5 Results of Composition Survey

Unit: % by Weight

Components		Domestic Waste			Waste transported to Landfills					
		Household			Provincial Landfill			Special Period Landfill		
		Dry	Rainy	Average	Dry	Rainy	Average	Dry	Rainy	Average
1	Paper	9	11	10	12	15	13	12	16	14
2	Aluminum	1	3	2	1	2	1	0	1	0
3	Steel and cost iron	1	1	1	1	0	0	1	1	1
4	Plastics	8	9	9	9	13	11	9	9	9
5	Glass	11	9	10	3	2	2	2	2	2
6	Textiles	1	3	2	3	2	3	3	6	4
7	Wood & Yard waste	9	2	5	5	2	3	9	3	6
8	Kitchen waste	60	61	61	62	63	62	53	60	57
9	Rubber	0	0	0	0	0	0	0	0	0
10	Leather	0	0	0	1	0	1	0	0	0
11	Others	0	1	0	4	0	2	11	3	7
TOTAL		100	100	100	100	100	100	100	100	100

Components		Commercial Waste								
		Hotel			Restaurant			Office		
		Dry	Rainy	Average	Dry	Rainy	Average	Dry	Rainy	Average
1	Paper	22	21	21	22	26	24	38	48	43
2	Aluminum	3	20	11	4	8	6	1	0	0
3	Steel and cost iron	1	2	2	2	1	1	0	1	0
4	Plastics	9	9	9	8	13	11	7	4	6
5	Glass	13	8	10	19	5	12	3	0	2
6	Textiles	0	2	1	0	2	1	1	1	1
7	Wood & Yard waste	0	0	0	0	1	0	0	2	1
8	Kitchen waste	52	38	45	45	45	45	51	45	48
9	Rubber	0	0	0	0	0	0	0	0	0
10	Leather	0	0	0	0	0	0	0	0	0
11	Others	0	0	0	0	0	0	0	0	0
TOTAL		100	100	100	100	100	100	100	100	100

Note: Dry: Dry season, Rainy: Rainy Season

(2) Chemical analysis of solid waste

The objective of the chemical analysis survey of municipal solid waste was to identify the chemical characteristics of buried solid waste at existing landfills and organic waste discharged from households and markets. The survey was conducted from June to July 2004. The items analyzed are shown in Table 2.2.6.

Table 2.2.6 Analysis Items in the Chemical Analysis Survey

Analysis Item	Buried Solid Waste	Organic Waste for Composting
	Samples were taken from Calle 100 , Guanabacoa and Ocho Vias landfills, at two depths (15cm, 1m) of three points, in each site	Samples were taken at 2 municipalities, 1 market , and 2 land fill sites; Calle 100 and Guanabacoa
Analysis Items (1): pH, EC, Cd, Zn, Cu, Pb, Cr ⁶⁺ , As, T-Hg, T-CN, PCB, Grease & Oil, Moisture, Ash content	Analyzed	Not Analyzed
Analysis Items (2): Combustible content, Lower calorific value	Analyzed	--
Analysis Items (3) : T-C, T-N, T-P, K, Na, Mg, Ca	--	Not Analyzed

The result of analysis shows that the samples of mixed buried solid waste in the existing landfills contained heavy metals such as lead and mercury. On the other hand, organic waste taken from the households and markets did not contain heavy metals at a hazardous level.

There are no standards for fertilizer in Cuba. Hence, the results of analysis of organic waste were compared with the standards in Japan (for cadmium, arsenic or total mercury) and found that the values do not exceed the standards.

As the C/N ratio of organic waste generated in households and markets was less than 20, it is regarded that these wastes can be used for composting.

The details of waste quality survey are contained in Supporting Report D2.

2.2.2 Recycling Market Survey

(1) Objective and methodology of the survey

The recycling activity in Cuba is being fully managed and controlled by UERMP (Association of Enterprises for the Recovery of Raw Materials), where one of the associated member enterprises is ERMP (Enterprise for the Recovery of Raw Materials) of Havana City. The recyclables are presently collected and sold to markets solely by UERMP. The material recovery from MSW is presently prohibited and, therefore, such system does not exist officially other than that carried out by DPSC in Havana City under the control of UERMP.

Since the ERMP has accumulated most of the information relating to the recycling in Havana City, the survey was conducted through interviews and discussion with a representative of ERMP and also some representative manufacturers that utilize

the recovered materials for their industrial production. The interviews were based on a questionnaire prepared by the Study Team.

The survey period was from May to June 2004. The study team's questionnaires covered type of business, recycling quantity, and the prices (selling and buying).

(2) Results of the survey

Table 2.2.7 shows the quantity of recyclable materials collected by the ERMP in the years 2000 and 2003. A relatively large difference is observed in the figures of 2000 and 2003, which indicates the quantity recovered is varying each year.

In 2003, the total quantity recovered was about 56,000 ton/year. The quantity of steel and cast iron dominated among the recovered materials, although the quantity was much less than in 2000. The recovered quantities of paper and cardboard, glass, and lead have also decreased, while those of aluminum, bronze, and copper jumped up from 2000.

Table 2.2.7 Materials Recovery by ERMP of Havana City

Material	Quantity Recovered (tons/year)	
	2000	2003
Paper and cardboard	10,718.7	7,469.3
Plastic	356.7	452.2
Steel and cast iron	70,939.3	29,975.6
Aluminum	668.5	3,599.5
Glass	428.9	224.3
Glass bottles	9,064.4	9,012.0
Fabric scraps	190.7	151.4
Fabric packs	3,350.8	2,501.2
Bronze	296.4	865.7
Copper	657.6	1,673.3
Lead	802.4	303.2
Total	97,474.4	56,227.7

Source: ERMP of Havana City, 2004

There are processing factories treating the recovered materials; all of such factories belong to UERMP. The materials treated by these companies include paper, plastics, non-ferrous metals, steel, and glass bottles.

However, the market prices of recyclable materials determined by UERMP could not be provided to the Study Team.

2.2.3 Survey of Quantity of MSW Hauled to Landfills

(1) Objective of the survey

The objective of the survey was to clarify (i) the ratio of the amount of waste collected to the total quantity of waste and (ii) the type of waste transported to the

existing landfills. The results were analyzed to identify actual collection quantity, type of wastes hauled, number of vehicles used, and their daily fluctuations.

(2) Outline of the survey

The survey was conducted at all 14 existing landfills: namely, 3 provincial, 1 municipal, and 10 special period landfills. As illustrated in Figure 2.2.1, the procedure of the survey was slightly different between the case of hauling from 11 municipalities and the case of hauling from institutions and other 4 municipalities.

The survey for the hauling from the 11 municipalities was undertaken for eight consecutive days (9th to 16th March, 2004) to count the number of UPPH and DMSC collection vehicles entering Calle 100 and Guanabacoa landfills. In addition to this survey for 8 days, the records of MSW quantity hauled to the other landfills from the remaining area were also gathered to make the survey complete.

The data sheet for weighing the waste at Calle 100 landfill contained the following items:

- Vehicle plate number to know the respective truck loading volume
- Type of vehicles to classify into compactor truck (C/T), dump truck (D/T), tractor-driven cart (T/C), horse-driven cart (H/C), and others if any
- Waste classification; classifying into domestic/commercial, bulky and construction, industrial, medical and other wastes
- Name of district, municipality, and institution to identify the collection area
- Weight of vehicle before and after dumping of waste
- Bulk density of waste as calculated
- Other information such as date, arrival time, etc.

The weight of collection vehicles with load and after unloading were measured by three trucks scales installed at the recycling center near the Calle 100 landfill, at the wharf of Havana Port and at a limestone crushing factory near the Guanabacoa landfill. Based on the results of the measurements, the weight and density of MSW and bulky waste per vehicle were calculated.

With regard to the wastes hauled from institutions by their own trucks, it was not possible to weigh the truck by the truck scale and hence, the weight was converted from the volume visually observed by using the assumed bulk density and the nominal loading volume of trucks.

Type of waste was identified by visual inspection by gate staff assigned at each landfill.

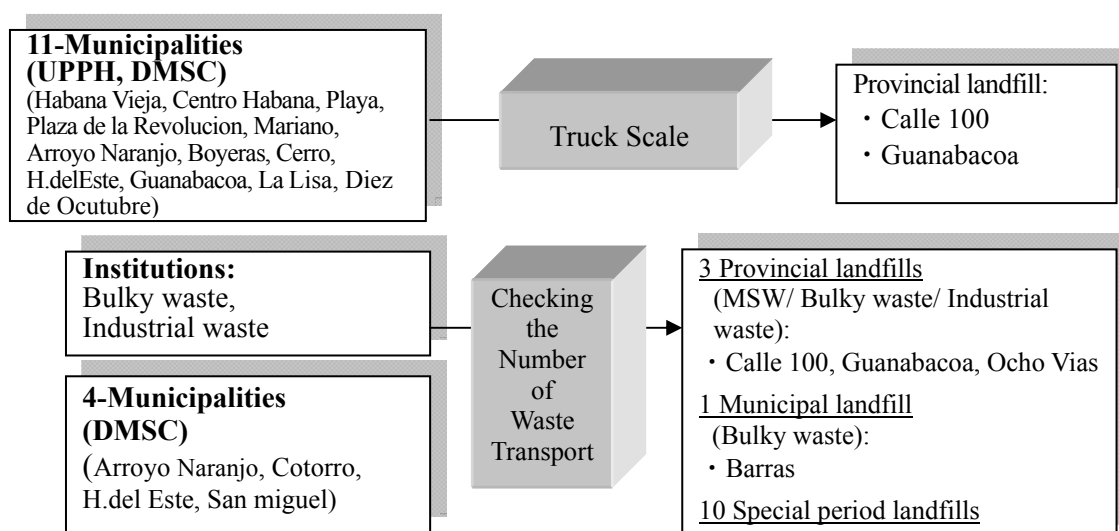


Figure 2.2.1 Procedure of Survey on MSW Quantities Hauled to Landfills

(3) Result of the survey

1) Number of vehicle trips for waste transportation

The number of vehicle trips transporting solid waste to landfills in the 8 days was about 6,400 in total. The solid waste transported to Calle 100 landfill was about 47% of the total, and that to Guanabacoa landfill and Ocho Vias industrial waste landfill were both about 13%. The remaining 27% was transported to the other municipal and special period landfills. The breakdown of the number of solid waste transportation is shown in Table 2.2.8. The two previous surveys, one of which was done in the dry season and the other in the rainy season, on waste quantity and quality provided similar results, as shown in Table 2.2.4.

Table 2.2.8 Number of Trips of Vehicles for Solid Waste Transportation

Classification of Landfill	Landfill	No. of Vehicles Trips		Ratio
		Total in 8 days	Average/day	
Provincial	Calle 100	2,992	374	46.9%
	Guanabacoa	834	104	13.1%
	Ocho Vias	819	102	12.8%
Municipal	Barreras	146	18	2.3%
Special period	Electrico	145	18	2.3%
	Fraternidad	219	27	3.4%
	Guasimas	130	16	2.0%
	Lugardita	137	17	12.1%
	P. Latina	52	7	0.8%
	Rincon	158	20	2.5%
	Las Cañas	83	10	1.3%
	Ell Vidrio	318	40	5.0%
	Los Perros	305	38	4.8%
Campo Florido	40	5	0.6%	
Total		6,378	798	100.0%

2) Weight measurement of vehicles

The total number of UPPH collection vehicles weighed by truck scale at Calle 100 landfill was about 1,830 during the 8 days, at an average of 229 per day. About 90% were mechanical vehicles such as C/T, D/T and T/C.

Bulk density of the waste was calculated for each vehicle type. The data was used to estimate the waste weight from institutions for which weighing was not conducted.

3) Bulk density of solid waste

Table 2.2.9 shows the bulk density of wastes by type as calculated from the measurements at the Calle 100 truck scale. The measurement experienced a little difficulty in the classification of type of wastes, since the wastes contained varieties of materials. The majority of waste was classified into domestic waste, and mixed wastes with bulky particles classified into bulky waste.

Based on the results of the measurements at Calle 100 site and also incorporating other data accumulated in previous surveys, experts of DMSC and UPPH determined the standard values of bulk density of wastes by types of waste and vehicles as per shown in Table 2.2.10. These values were used for estimating the total quantity of wastes collected from whole area, including the wastes for which the weight was not measured.

In addition, bulk density of waste transported by H/C was calculated based on the sample data of weights measured at a truck scale in the recycle center on 27 May 2004. The results are listed in Table 2.2.11 below.

Table 2.2.12 shows the results of weighing typical construction waste measured at the recycle center. The same truck was weighed twice on two different occasions.

Table 2.2.9 Summary of Average Bulk Density of Waste Measured at Calle 100

Unit: kg/m³

Type of Vehicle	Domestic and Commercial waste	Bulky waste		Industrial waste	Medical waste	Others
		Construction waste	Bulky waste			
C/T	492.6		392.2			
D/T	211.1	443.0	275.4	239.5	178.2	326.3
T/C	167.5		145.8			145.4
H/C (Urban)	85.7					

Table 2.2.10 Summary of Evaluated Value of Bulk Density of the Waste

Unit: kg/m³

Type of Vehicle	Domestic and commercial waste	Bulky waste		Industrial waste	Medical waste	Other
		Construction waste	Bulky waste			
C/T	500	-	400	240	-	240
D/T	220	450	280	210	180	210
T/C	170	210	150	-	120	240
H/C (S-Urban)	200	-	-	210	-	-
H/C (Remote)	100	-	-	-	-	-
Other	380	140	100	210	-	240

Table 2.2.11 Bulk Density of Waste Transported by H/C

Type of Vehicle	Type of Waste	Size & Capacity of Cart				Net Weight (kg)	% of Waste Loading	Bulk Density (kg/m ³)	Municipality
		W (m)	L (m)	H (m)	m ³				
H/C No.1	Mixed waste	1.7	1.7	0.75	2.17	420	0.95	204	Boyerros
H/C No.2	Mixed waste	1.2	1.5	0.50	0.90	340	1.20	315	Boyerros
Average					1.57			260	

Table 2.2.12 Bulk Density of Construction Waste

Type of Vehicles	Source of Construction Waste	Capacity of D/T		Net Weight (ton)	% of waste loading	Bulk density (kg/m ³)	Remarks
		Plate Number	m ³				
D/T No.1	Institution	HUN204 (KPA3)	8.0	8.30	1.0	1,037	Ministry of Construction
D/T No.2	Institution	HUN204 (KPA3)	8.0	7.84	1.0	980	
Average			8.0			1,000	

2.2.4 Time and Motion Survey

(1) Objective of the survey

The objective of this survey was to identify the current condition of MSW collection and transportation works, and to study the appropriate number of bins and operation method of collection vehicles.

(2) Outline of the survey

The time and motion survey of collection vehicles including H/C was conducted on four days (two days for the old city area and two days for the semi-urban area) from 24 April to 3 June 2004. The survey also examined the present conditions of each type of collection system using the various types of vehicles operated by the UPPH and the DMSC.

Four survey routes were selected: No.1 and No.4 routes being collected by C/T in Centro Habana and Habana Vieja municipalities, No.2 route by T/C in Regla municipality, and No.3 route by H/C in Arroyo Naranjo municipality. The vehicles

were monitored over the complete route of travel originating from the maintenance workshop where they are parked up to their return to the workshop. Time of work and moving distances of every activity in sequence were recorded in the survey. The major items recorded were as follows:

- Operation distance and traveling speed from the first parking lot to the end of work, moving between collection points as well as to landfills
- Operation time, which includes meeting time at the office, preparation time, traveling time starting from and back to the parking lot, moving time for collection, loading time at collection stations, and dumping time
- Condition of collection points and their containers

The conditions of the survey routes are shown in Table 2.2.13.

Table 2.2.13 Conditions of the Survey Routes

	Route-No.1 (Old City Area)	Route-No.2 (Semi-urban Area)	Route-No.3 (Semi-urban Area)	Route-No.4 (Old City Area)
Date of Survey	24 April 2004 (6:40am-1:30pm)	30 April 2004 (6:05am-2:00pm)	7 May 2004 (6:15am-11:30am)	3 June 2004 (7:30pm-2:30am)
Municipality	Centro Habana	Regla	Arroyo Naranjo	Habana Vieja
Route	Pueblo Nueve	Lama Model	Los Moros	Consejo Tallapierra
Type of Collection Vehicles	Specialized Collection Vehicle (Compactor Truck: C/T: HUR 388: 18 m ³ , Russian made, June 2004)	Traditional Collection Vehicle (Tractor-Driven Cart: T/C: 10 m ³)	Traditional Collection Vehicle (Horse - Driven Cart: H/C: 1.8 m ³)	Specialized Collection Vehicle (Compactor Truck: C/T:HKF647: 18 m ³ , French made, May 2003(Grant from UN)
Type of Bins	770~1100 liter PVC Containers	Plastic Bags, Metal barrels, Boxes, etc.		770~1100 liter PVC Containers
Survey Area (km ²)	0.51	1.96	0.18	2.60
Population	30,632	9,943	1,368	42,740
Number of Houses/Apartment Buildings	1,025	2,411	366	-
Population per Building (people/building)	29.60	4.10	3.70	-
Population Density per Area (people/km ²)	59,533	5,073	7,600	16,438
Number of Collection Points	79	176	143	114
Number of Waste Pick Up/Bins	103	404	198	221
Type of Area	Mixture of residential, commercial and tourist areas	Typical Residential area and close to Industrial area,	Typical residential area in suburb	Mixture of residential, tourist and industrial areas,

(3) Results of the survey

1) Quantity of MSW collection

Collected waste quantity observed in the survey is shown in Table 2.2.14.

The survey clarified the amount of MSW collected as 15.1 tons/day from Centro Habana Municipality, 3.4 tons/day from Regla Municipality, 0.4 tons/day from Arroyo Naranjo Municipality and 23 tons/day from Habana Vieja Municipality. The biggest collection point was 203 kg/day carried by C/T (HKF647 made in France), while the smallest was 2.8 kg/day collected by H/C. The compression factor of waste collected in Centro Habana by C/T vehicle (HUR388 made in Russia in 2003) was about 2.5 and that was less than the designed value. HKF647 (the French 2002 model) had a compression factor of more than 4.5. Although HKF647 produced a better compression factor than the Russian model, its price (US\$121,000) was more than twice that of the Russian one (US\$50,000).

The waste generation per capita was about 0.5 kg from the C/T collection area and 0.3 kg from the H/C collection area.

Table 2.2.14 Quantity of Collected Waste

Description	C/T: HUR 388	T/C	H/C	C/T: HKF 647	Average
Total Quantity of Collected Waste (kg/day)	15,100	3,410	400	23,200	10,528
Total Quantity of Collected Waste (lit/day)	88,220	17,100	3,900	174,500	70,930
Collected Quantity per capita (kg/capita)	0.497	0.343	0.292	0.543	0.419
Collected Quantity per home (kg/house)	14.70	1,414	1,093	-	-
Number of Trips	2	2	3	2	2
Quantity per Station (kg/collection point)	191.1	19.4	2.8	203.5	104
Compression Factor of the C/T Vehicle	2.45	-	-	4.85	3.65

2) Operation time

The operation time was about 340 to 400 minutes in C/T collection system, 460 minutes in the T/C system, and 260 minutes in the H/C system as shown in Table 2.2.15. The operation time of the T/C was the longest of the four collection systems.

In the case of collection by C/T and T/C, a longer time can be allotted for transportation compared with the case for H/C. C/Ts spend almost the same proportion of time on each activity (average of 25% for each). The largest portion of time consumed in T/C collection is 34% for loading, while H/Cs spend 43% of time for moving.

Table 2.2.15 Operation Time for MSW Collection and Transportation

Description		C/T:HUR 388		T/C		H/C		C/T:HKF 647	
Operation Time (min)	Loading	84	20.5%	155	33.9%	30	11.4%	103	29.9%
	Moving	106	25.9%	67	14.6%	113	43.4%	69	20.0%
	Transportation	110	26.9%	107	23.4%	48	18.5%	85	24.8%
	Preparation/Dumping	109	26.7%	129	28.1%	70	26.7%	87	25.3%
	Total	409	100.0%	458	100.0%	261	100.0%	344	100.0%

Note: Moving time is the time between loading spot to another spot, Transportation time is the time from the final loading spot to the landfill.

Table 2.2.16 shows the unit time consumed per collection station, per collected weight and collected volume. The collection time per collection point was longest in the case of C/T, being about 3.8 to 5.2 minutes. The collected weight per minute was largest for C/T, being about 37 kg for the HUR 388 and 68 kg for the HKF 647. They were 25 and 65 times the weight collected by H/C which was 1.5 kg/min. The volume collected per minute showed similar figures. Overall, collection by C/T seems to be more efficient compared with those by other vehicles.

Table 2.2.16 Operation Time by Type of Vehicles

Description		C/T:HUR 388	T/C	H/C	C/T:HKF 647	Average
Unit Time per Collection Point (min/point)	Loading	1.06	0.88	0.21	0.90	0.76
	Moving	1.34	0.65	1.10	0.60	0.92
	Transportation	1.39	1.04	0.47	0.75	0.91
	Preparation/Dumping	1.38	1.25	0.68	0.76	1.02
	Total	5.17	4.45	2.54	3.01	3.79
Weight Collected per Minute (kg/min)	Loading	180.51	21.93	13.47	226.34	110.57
	Moving	143.06	50.93	3.53	337.95	133.87
	Transportation	137.27	31.79	8.28	273.17	112.63
	Preparation/Dumping	138.53	26.43	5.71	266.67	109.34
	Total	36.99	7.43	1.53	67.62	28.39
Volume Collected per Minute (lit/min)	Loading	1,055	110	131	1,702	749
	Moving	836	255	34	2,542	917
	Transportation	802	159	81	2,055	774
	Preparation/Dumping	809	133	56	2,006	751
	Total	216	37	15	509	194
No. of Trips (times)		2	2	3	2	2.25

3) Operation distance

The total operation distance of vehicles for collection and transportation is shown in Table 2.2.17. The figure of C/T, 70 to 80 km per day including travel distance to landfills, was the longest among the vehicles. The H/C traveled only 6.3 km per day. The total moving distance from station to station for collection of waste was 13 to 22 km in the case of C/T and 7.4 km in the case of T/C. The C/T is more than five to six times longer than the 3 km observed for H/C.

Table 2.2.17 Daily Operation Distance of Collection Vehicles

Unit: km

Operation Distance (km)	C/T:HUR 388			T/C			H/C				C/T:HKF 647			Ave.
	1st trip	2nd trip	Total	1st trip	2nd trip	Total	1st trip	2nd trip	3rd trip	Total	1st trip	2nd trip	Total	
Moving	7.50	6.26	13.76	3.61	3.73	7.34	0.76	1.84	0.67	3.27	5.85	16.49	22.34	11.7
Transportation	39.00	29.00	68.00	11.92	15.76	27.68	1.50	0.90	0.60	3.00	17.50	28.50	46.00	36.2
Total	46.50	35.26	81.76	15.53	19.49	35.02	2.25	2.74	1.27	6.26	23.35	44.99	68.34	47.8
Ratio	56.9%	43.1%		44.3%	55.7%		36.0%	43.7%	20.3%		34.2%	65.8%		
Dumping Site	Calle 100			Guanabacoa			Fraternidad				Calle 100			

4) Operation speed

Operation speed recorded for each type of collection vehicles is shown in Table 2.2.18.

The average operation speed was calculated as 12 km/hr for C/T collection, 4.6 km/hr for T/C collection and 1.4 km/hr for H/C collection. There was no notable difference in operation speed of C/T and T/C between the 1st and 2nd trips. However, a slowing of up to 30% to 40% was observed in the speed of H/C from the first to third trips.

Table 2.2.18 Operation Speed of Collection Vehicles

Operation Speed (km/hr)	C/T:HUR 388			T/C			H/C				C/T:HKF 647			Ave.
	1st trip	2nd trip	Ave.	1st trip	2nd trip	Ave.	1st trip	2nd trip	3rd trip	Ave.	1st trip	2nd trip	Ave.	
Moving	8.0	7.6	7.8	6.4	6.8	6.6	2.2	1.5	1.9	1.9	14.5	22.3	19.5	5.4
Transportation	39.7	34.1	37.1	13.9	16.9	15.5	4.5	3.3	3.1	3.6	29.5	34.7	32.5	18.8
Total	13.1	10.8	12.0	4.2	4.9	4.6	1.7	1.4	1.1	1.4	10.7	12.7	12.0	6.0
Coefficient	1.1	0.9	1.0	0.9	1.1	1.0	1.2	1.0	0.9	1.0	0.9	1.1	1.0	

5) Number of staff

The average number of staff for different types of collection is shown in Table 2.2.19. The total number of workers to load MSW was four to five including one driver for the C/T collection. The number of staff differs with the type of collection vehicle and collection route. In T/C collection, two members stayed in the cart while the others manually picked up the waste discharged on both the right and left sidewalks. The H/C collection was operated by one person who picked up the waste on the sidewalk while giving commands to the horse to control collection speed.

Table 2.2.19 Number of Staff Engaged in Waste Collection

	C/T:HUR 388	T/C	H/C	C/T:HKF 647	Average
Driver	1	1	1	1	1
Worker	2	4	0	3	2.75
Total	3	5	1	4	3.25

2.2.5 Water Quality Survey at the Landfill Site

(1) Objective of the survey

The objective of the water quality survey was to measure the physical and chemical characteristics of water in and around the landfills in Havana city. The results of the survey were used to assess the environmental impact of the landfills on the surrounding areas.

(2) Methodology of the survey

1) Sampling point

Sampling of water was conducted in and around the landfills. The total number of sampling points was 19 in the dry season and 22 in the rainy season. The details of the sampling points are given in Table 2.2.20.

Table 2.2.20 Water Sampling Point

Landfill	Sample	Sampling Point	
		Dry season	Rainy season
Calle 100	Surrounding river water	4 points on the Almendares River	4 points on the Almendares River
	Groundwater	5 points	4 points
	Leachate at landfills	5 points	5 points
Guanabacoa	Surrounding river water	2 points	2 points
	Groundwater	1 point	1 point
	Leachate at landfills	1 point	2 points
Ocho Vias	Groundwater	1 point	1 point
	Leachate at landfills	-	2 points
Campo Florido	Groundwater	-	1 point
Total		19 points	22 points

2) Survey item and frequency

The items of water quality parameters tested are shown in Table 2.2.21.

Table 2.2.21 Survey Item

Survey Item and Analytical Parameter
(1) pH (2) DO, (3) EC, (4) TDS, (5) COD, (6) BOD, (7) SS, (8) Coliform bacteria, (9) Cadmium (Cd), (10) Zinc (Zn), (11) Copper (Cu), (12) Lead (Pb), (13) Chromium (Cr ⁶⁺), (14) Arsenic (As), (15) Total Mercury (T-Hg), (16) Total Cyanide (T-CN), (17) Ammonia Nitrogen (NH ₄ ⁺), (18) Nitrate Nitrogen (NO ₃ ⁻), (19) Nitrite Nitrogen (NO ₂ ⁻), (20) T-N, (21) T-P, (22) Grease and oil, (23) Phenol, (24) Detergent, (25) Acidity and alkalinity, (26) Temperature, (27) Color, (28) Turbidity, (29) Odor, (30) Volatile solids

Note: Date, time, weather and air temperature were recorded when each sample was collected.

3) Boring and installation of monitoring wells

Boreholes were drilled at five locations, four in the Calle 100 landfill and one in Ocho Vias landfill. The boreholes were deep enough to reach the main aquifer. Before commencement of the boring work, the aquifer depths in the Calle 100 and the Ocho Vias area were studied. Cores were collected and boring logs were prepared based on visual observation of the cores.

All five boreholes were used as monitoring wells by inserting a PVC casing pipe supplied by the Study Team. The pipe was installed to the depth reaching the bottom of the aquifer. The gap between the borehole and the casing pipe was filled with coarse sand, and sealed at the top with a metal cover plate in order to prevent contamination of the well from the surface.

The location and depth of installed wells are shown in Supporting Report D3.

(3) Results of the survey

The details of the survey results are contained in Supporting Report D3. The following are the summary of findings from the survey:

1) Dry season

The survey results showed that the water quality of leachate is highly degraded and that of river water less degraded. The BOD levels were 230 to 2,474 mg/l for leachate, 3 to 132 mg/l for groundwater, and 11 to 65 mg/l for river water. The heavy metal levels were relatively low in all samples, except for one leachate sample taken at Calle 100 (Sample No. C5). This sample (C5) was taken from a creek in the landfill. The creek received the inflow of effluents discharged from sewerage and a nearby car factory. It was observed from the site condition that the heavy metal content in this leachate was due to the effluent from the car factory.

The results were compared with the water quality standards for inland surface water because there are no environmental standards for leachate in Cuba. Regarding the leachate, the COD, BOD, T-N and T-P level of all sampling points exceeded the acceptable levels designated in the surface water standards. The groundwater, B1 and B5 in Calle 100 and E1 in Guanabacoa exceeded the standards for some parameters. Regarding the river water, samples A1 in Calle 100 and D1 and D2 in Guanabacoa also exceeded the standards in some parameters. Refer to Supporting Report D3 for further details.

2) Rainy season

The results showed that the water quality of leachate is most degraded and that of river water less degraded, same as for the results in the dry season. The BOD levels were 168–1,128 mg/l for leachate, 372 mg/l for groundwater, and 11–46 mg/l for river water.

Comparing the results of the rainy season to those of the dry season, no particular difference in the tendency of water quality was recognized.

2.2.6 Environmental Awareness Survey for the Citizens in General and Residents Living around MSW Facilities

(1) Objectives of the survey

Consideration of the social aspects of the project is important from two viewpoints. The first is to minimize the negative impacts of project activities on the population, particularly in the areas surrounding the dumping sites (landfills), for which corrective measures must be taken. The second is to raise the awareness of the population in order to assure their active participation in the project's activities.

A questionnaire survey was carried out to gather information regarding current awareness, as well as people's views on the problems regarding MSWM, thereby serving as a baseline. Special attention was given to the population living in the immediate surroundings of existing landfills.

The questionnaire dealt with the following issues:

- General characterization of the respondents
- Perception of the problems
- Knowledge of possible solutions
- Disposition to contribute to solutions

These issues partly refer to the general perception of MSWM, and partly to the specific problems caused by landfills. Therefore, the results of the survey were used to assess the respondents' awareness and also to adjust the implementation of the pilot project as necessary.

In most questions, the answers were multiple choice; however, in some cases, the questions were purposely open-ended in order not to bias the answers of the respondents.

(2) Outline of the survey

In order to conduct the questionnaire survey, 15 surveyors, one each for each municipality, were trained through a half-day workshop to gain the knowledge required for conducting the survey. Firstly, they were given a brief explanation of the project and potential problems related to MSWM, focusing particularly on the social aspects. Secondly, the method of survey regarding how to select the sample respondents and how to fill the answers in the questionnaire form.

In each of the 15 municipalities a minimum of 10 persons were interviewed. In those municipalities that have a landfill in their territory, half of the questionnaires were addressed to residents in the immediate surroundings of the landfill sites in order to collect the opinions of those who may suffer from the direct impacts of the sites. This was applied to the areas of the two provincial landfills, Calle 100 and Guanabacoa, and the three special period landfills, El Rincón, Las Cañas and Fraternidad.

In selecting the sample respondents, the following two criteria were applied:

- Equal distribution in consideration of the locational distribution of “circumscriptions” (neighborhoods).
- Where a landfill existed in the municipality, 50% of the questionnaires were applied in its immediate surroundings.

(3) Results of the survey

That there are problems in the MSWM of Havana City was confirmed by the fact that 82% of respondents (128) were aware of the existence of such a problem.

Of all the respondents, 53% discharge their waste in containers. Only 25% of the respondents considered that there are enough containers available. Most of the respondents believed the availability of containers is fair (56.6%). Collection frequency was considered inadequate (55%). Regarding the collection time, 65% of the respondents considered it appropriate. Collection was carried out by C/T in the areas of 51% of the respondents, but this percentage declined to 7.4% in areas close to landfills.

A total of 70% of the respondents think the current collection system is suitable, whereas only 44% of the respondents living close to the landfills think so.

People get information about MSWM comes from different sources: TV (57%) and People’s Power Accounting Meetings (41%) are the main ones. Other important sources are radio broadcastings (21%) and the press (23%).

There were 142 respondents (91%) who expressed willingness to join in the action program for solving the problems. Somehow all respondents reused and recycled their plastic and glass containers (bottles and cans), whereas 75% were willing to separate their garbage before collection.

Only 45% of the respondents had heard about compost. However, after listening to the explanation, most of them showed a positive attitude to using it.

CHAPTER 3 CURRENT CONDITIONS OF SOLID WASTE MANAGEMENT

3.1 Organization and Institutional Frameworks

Solid waste management (SWM) in Havana, as well as in Cuba, is a governmental responsibility shared among the Provincial and Municipal Governments for operational activities, and among the MEP, MINSAP, and CITMA for planning, budgeting, controlling and setting guidelines.

Operational activities, such as MSWM, are done by regularly budgeted government institutions or by government “company-like” institutions. In Havana City, within the SWM sector, both types of institution also coexist, which are named herein “budgeted” institutions in the case of regular government institutions, or “Aurora” institutions in the case of company-like institutions with a higher degree of autonomy.

3.1.1 Organizational Structure for MSWM of Havana City

Solid waste collection, street sweeping and disposal of solid waste are shared among the Provincial and the 15 Municipal Governments by the UPPH which belongs to the DPSC, and the DMSC. Each DMSC belongs to one of the 15 municipalities of the province. For street sweeping, the operation is further decentralized through the 105 communal zones (ZC), which administratively belong to the 15 municipalities.

The UPPH and DMSC, therefore, are subject to the usual government structure of Havana City, which is headed by its Provincial Administration Council (CAP). In two municipalities, however, the institution in charge of SWM is an Aurora enterprise, which is a government unit belonging to the municipalities concerned and organized as an enterprise.

The responsibility for management planning and budgeting goes primarily to the MEP. This Ministry allocates and controls the budget of all the DPSC and DMSC of the country and sets the guidelines as well as the planning for the MSWM sector, which is implemented by the DPSCs.¹

The MINSAP sets guidelines on health protection and sanitary control, and CITMA has a role in dictating the guidelines for environmental protection related to MSWM, especially for its disposal, as well as monitoring and controlling it.

¹ There are four Aurora units in total (ref, Section 4.1). Of the four, two are in active operation in two municipalities (Plaza and Habana Vieja), the other two are operating only at a small scale.

Other organizations and institutions that deal with MSWM, not operationally but rather demanding and supporting some recycling and environment awareness activities, are the “masses organizations”, which are very active in Cuba; namely the Cuban Students Union, the Federation of Cuban Women (FMC) and the Committee for Defense of Revolution (CDR).

3.1.2 Responsibilities, Organization and Staffing of the Related Organizations

The DPSC is responsible for most of the collection services through the UPPH, although the DPSC’s responsibilities go beyond solid waste collection and street sweeping, taking care also of parks and gardens, cemeteries, the zoo, public spaces furniture, etc. For the collection area, refer to Table 3.5.2 in Section 3.5.2. For financial data of each organization, refer to Data Book D4 to D9

The UPPH also supervises and controls the work done by its municipal counterpart, the DMSC, which is responsible for manual street sweeping, collection of demolition debris, branches (trees), bulky waste, and collection made by D/T, T/C and H/C.

The CITMA provincial delegation monitors and controls operations related to the storage, collection, transport, and disposal of solid waste done by DPSC and the DMSC. The CITMA delegation also works in accordance with the Cuban Environmental Agency (AMA). This agency sets the guidelines for environmental protection that are monitored and controlled through the Inspection and Control Centers. The CITMA delegation in Havana city has about 80 employees, 75% with university degrees.

Staff of the UPPH and the DMSC related to MSWM services is around 4,400 personnel. For the SWM staff distribution, refer to Data Book D3

Operation staff in the workshops (WSs) and final disposal sites have sufficient experience and are well trained. However, there is a lack of specific technology of solid waste management, especially on sanitary landfill systems and planning and design of SWM systems. Therefore, additional knowledge and training for improvement of operations of SWM system in Havana City is required.

3.1.3 Laws and Regulations Related to Solid Waste Management

In Cuba, the legal and regulatory framework is based on the National Constitution of 1976, modified later (1992) by the National Assembly of People’s Power. Although there is no national laws or regulations concerned only with SWM, the National Constitution has several articles dealing with environmental care and

control, especially Article No. 27, which says that the Cuban State is responsible for the environment and the natural resources of the country.

Nevertheless some national laws deal with solid waste related matters, such as:

- Law 1288 of 2/Jan/1974 and its corresponding “by-laws”: Decree 3800 of Jan 04, 1974 – Deals with recyclable materials collection
- Law 33 of 10/Jan/1981 – Deals with environment protection and rational use of natural resources, and says in Chapter 2, Section 8, that collection, transportation, final disposal and economic recovery of wastes shall not impair the environment.

Concerning the Technical Norms for SWM, the most important existing norms are the following:

- NC 133: 2002-Urban solid wastes. Storage, collection and transport, environmental and hygienic-sanitary requirements.
- NC 134: 2002-Urban solid wastes. Treatment environmental and hygienic-sanitary requirements
- NC 135: 2002-Urban solid wastes. Final disposal, environmental and hygienic- sanitary requirements

Concerning recycling of solid wastes, the national recycling law (Law 1288 of January 1975) makes the collection of recyclable scraps, goods and raw materials mandatory for all government bodies, giving to UERMP all the responsibility to manage and operate all the recycling operations in the country, from collection, processing and delivering it to industries for use as secondary raw materials.

At the Havana City provincial level, the law concerned with MSWM is Decree No. 272 of 20/Feb/2001 and the Law Decree No.99 of 25/Dec/1987: “Offenses For City Cleanliness” and Resolution No. 16/94: “Regulation of Hygiene and Beautification for Havana City“. These codes are used for curbing mismanagement of solid wastes and imposing fines for those that violate the law.

The main MSWM activities done by the DMSC and the DPSC are ruled by a guideline issued by the DPSC, named “Guidelines Documents of the Fundamental Activities of the Communal Zones”, 2001. This document specifies the duties and responsibilities of the Communal Zone chief, the administration manager and the hygiene manager. These duties and responsibilities are well described, as well as the methodologies that shall be used for street sweeping, specialized collection, environmental sanitation, etc.

3.1.4 Existing Plan of MSWM

Presently, Havana City does not have a systematic long term plan for MSWM to guide the study and preparation of future plans for the city. However, because of the urgent requirement, the following planning matters have been studied by the government organizations responsible.

- Planning of site selection for the new landfill required after the closing of Calle 100
- Planning for the construction of New Guanabacoa landfill (design and engineering work already started)
- Planning for the construction of transfer stations
- Planning for a new MSWM organization dealing with collection and landfill operation

3.2 Financial Situation

3.2.1 Government Expenditure on MSWM

The budgets of the state government and the fiscal balance are summarized in Table 3.2.1.

The fiscal deficit has gradually increased and reached 3.3% of GDP in 2003, which is still regarded as an endurable level. Large spending items are education, public health, social security, and subsidy for state enterprises.

It is noted that the expenditure for housing and community services that include MSWM showed an increase of 26% from 763 million pesos in 2000 to 961 million pesos in 2003. This increase was more than the increases in overall expenditure (19%) and the GDP (15%) during the same period.

Table 3.2.1 State Budget and Fiscal Balance

(Million pesos at current prices)

Year	2000	2001	2002	2003
Revenue				
Direct Taxes	3,977	4,354	4,473	4,797
Indirect Taxes	6,732	6,386	7,259	8,097
Non-taxation income	4,206	4,294	4,465	4,655
Total revenue	14,915	15,034	16,197	17,548
Expenditure				
Current expenditure for budgeted activity	9,233	10,406	11,469	12,629
Education	2,095	2,369	2,752	3,297
Public health	1,684	1,797	1,923	2,028
Defense	880	1,274	1,262	1,267
Social Security	1,786	1,870	1,985	2,054
Housing and community services	763	827	874	961
Other activities	2,027	2,269	2,674	3,022
Current expenditure for enterprise activity	3,076	2,622	3,286	3,493
Economic assistance to agricultural cooperatives	99	64		
Capital spending	1,749	1,990	1,949	2,083
Extraordinary spending	-	-	-	-
Fund for budget stabilization	1,000	140		
Financial operation	430	550	489	418
Total expenditure	15,587	15,771	17,193	18,622
Balance	-672	-738	-997	-1,074
GDP	28,206	29,557	30,680	32,337
Balance % of GDP	-2.4%	-2.5%	-3.2%	-3.3%

Source: "Statistics yearbook of Cuba 2003" National Office of Statistics

The increase in state current expenditure on MSWM is shown in Table 3.2.2. The expenditure more than doubled from 138 million pesos in 2000 to 285 million pesos in 2004. Most of the salary expenditure is in the currency portion of CUP, while the operation expenditure contains both CUC and CUP portions.

Table 3.2.2 State Expenditure on MSWM

(Million pesos at current prices *)

Year	2000	2001	2002	2003	2004**	
Collection	Operation	91	83	93	115	180
	Salary	39	43	44	51	83
	Total	131	126	138	166	262
Final disposal	Operation	6	6	7	12	14
	Salary	2	3	4	5	9
	Total	8	9	11	17	23
Total	Operation	97	89	101	127	193
	Salary	41	46	48	56	92
	Total	138	135	149	183	285

* CUC and CUP are added up at par.

** Figures are budgeted amounts.

Source: Ministry of Economy and Planning

For a breakdown of the state expenditures on MSWM, refer to Data Book D.4-D.9.

3.2.2 MSWM Expenditures in Havana City

There are four main MSWM service providers in Havana City, (i) UPPH, (ii) Aurora Plaza Company, (iii) Aurora Habana Vieja Company, and (iv) DMSC (including small Aurora units). As these providers' operations are interrelated, the MSWM revenues and expenditures of Havana City should be examined in a consolidated manner. However, the lack of accounting information of these providers made the consolidation difficult. Hence a simple addition of figures available for each agency was attempted as shown in Table 3.2.3.

Table 3.2.3 Revenues and Expenditures of MSWM in Havana City

	CUP (Peso 000)	CUC (Peso 000)	CUP + CUC * (Peso 000)
Revenue			
UPPH	594	340	934
Aurora Plaza	9,339	227	9,566
Aurora Habana Vieja	8,189	145	8,334
DMSCs	10,141	1,038	11,179
Total	28,263	1,750	30,013
Expenditure			
UPPH	62,234	467	62,701
Aurora Plaza	6,741	198	6,939
Aurora Habana Vieja	5,995	201	6,196
DMSCs	81,910	1,123	83,034
Total	156,880	1,989	158,870
Surplus (deficit)			
UPPH	-61,640	-127	-61,767
Aurora Plaza	2,598	29	2,627
Aurora Habana Vieja	2,194	-56	2,138
DMSCs	-71,769	-85	-71,855
Total	-128,617	-239	-128,857

Source: Year 2003 data provided by DPSC

*CUP and CUC are added up at par in this table

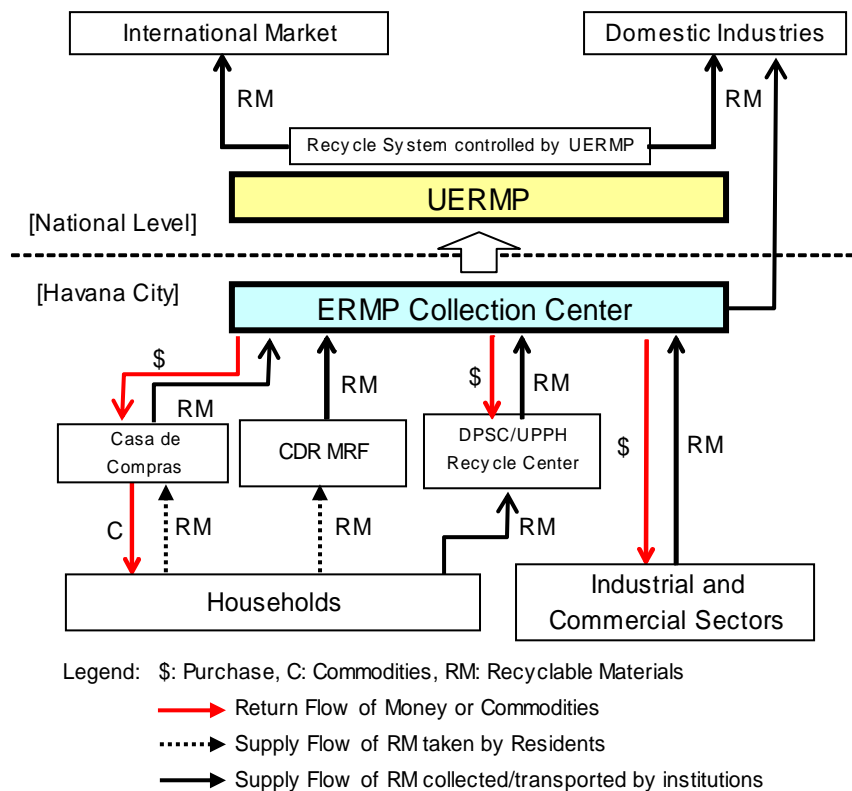
UPPH itself is a part of the government system and subject to the governmental (budgetary) accounting system. Thus, UPPH basically entails expenses that cannot be fully recovered by revenues. The two Auroras can charge tariffs and collect bills from most of the service users in their territories, which results in them having sizable operational profits. DMSC are sections within municipal governments. They can charge tariffs and collect bills from non-domestic service users. However, unlike Auroras, DMSC are not business oriented, so that only a limited number of service users are charged. Overall, the MSWM operation of Havana City is unprofitable, with a deficit of as much as 129 million pesos.

The capital investment amount of Havana City MSWM in 2003 was approximately 60 million pesos when the CUC and the CUP portions were aggregated at par. The CUC investment portion alone was about 0.2 million pesos.

3.3 Recycling

3.3.1 Existing Recycling System

Only the UERMP has the legal right to control activities relating to material recovery and setting of domestic trading prices in Havana City as well as in the rest of Cuba. Therefore recyclable materials collected by DPSC/UPPH have so far been flown into the recycling system of the UERMP. Figure 3.3.1 describes the current flow of recovered recyclable materials in Havana City and Cuba.



Note : Data of the Recycling Quantity for each Organization is not available

Figure 3.3.1 Flow of Recovered Recyclable Materials in Havana City and Cuba

(1) Material recovery at UERMP and ERMP

In November 1961, Commander Ernesto Che Guevara inaugurated the UERMP. The main objective of this establishment is the recovery, processing, and marketing of reusable solid waste produced in the industrial/commercial sector and households, but the majority of recovery of recyclable materials has been from the industrial sector.

To date, the enterprises for the recovery of raw materials (ERMP) have been established in every province. The UERMP is the umbrella association of all ERMPs but practically speaking, each ERMP itself handles the recyclables to sell in the Market under orders of UERMP.

The recyclable material is gathered by UERMP through each ERMP using the following channels:

- The network of “Casas de Compras” is a network of purchasing houses, where people can bring recyclable materials they collect by themselves to sell or exchange.
- The districts of the CDRs. People can also bring the recyclables collected to CDRs.
- The students’ activity named MRF (Future Recovery Movement); occasionally they schedule activities to collect raw materials

Table 3.3.1 shows the types of materials recovered in Cuba, which includes plastics, glass, textiles, and other materials listed in the table. Table 3.3.2 shows the quantity of material recovered by ERMP of Havana City. It represents 18 to 30 tons per day from municipalities. The market price for some of these recyclable materials as reported by ERMP during the Study was, for example, CUP700 per ton for plastic, CUP160 per ton for paper, CUP80 per ton for glass, US\$600 per ton for aluminum and US\$35 for steel.

Table 3.3.1 Types of Recyclable Materials Recovered

Item	Recyclable Materials
Plastics	Plastics
Glass	Bottles
Textile	Textile
Paper and cardboard	Books, news paper, cardboard
Wood	Wood
Ferrous scraps:	Scraps of steel, fused iron, stainless steel
Non-ferrous scraps	Scraps of aluminum, copper, bronze, Lead
Other metal scraps	Zinc, silver, tin
Vessels, bottles:	plastic bottles, card board, glass bottles

Source: UERMP, 2004

Table 3.3.2 Quantity of Materials Recovered by ERMP of Havana City

Source	Unit: tons/day	
	2000	2003
Industry	234.2	94.4
Municipality	17.8	34.3
Total	269.8	163.0

Source: ERMP of Havana City, 2004

(2) Material collection at the recycling center of DPSC/UPPH

The DPSC in Havana City started operating a recycling plant at Calle 100 site in 2000. This was the first solid waste processing plant in the country. The plant is only equipped with scrap cutting blades and can/cardboard press machines. The recyclable materials are also collected and stored in the area of the Guanabacoa

landfill and Ocho Vias industrial landfill after manual separation. These two landfills do not have any processing equipment for material recovery.

The material recovery by UPPH in the last several years is shown in Table 3.3.3. The collected materials were sold to the system of UERMP. The quantity of recovered material varies by year as represented, for instance, by the figures of glass, plastic and lead.

Table 3.3.3 Quantity of Materials Recovered by UPPH of DPSC (2001-2004)

Recyclable Materials	2001 (ton/yr)	2002 (ton/yr)	2003 (ton/yr)	2004 (ton/month)			
				Jan.	Feb.	Mar.	Apr.
Aluminum	72.0	65.0	84.0	5.8	2.5	3.1	6.5
Paper and cardboard	566.0	525.0	369.0	95.0	51.9	9.3	5.2
Glass	125.0	404.0	127.8	6.1	-	1.0	-
Plastic	25.0	14.2	119.0	7.4	10.3	7.7	5.5
Lead	2.0	34.4	100.0	10.5	13.2	5.1	15.3
Ferrous scraps	1,192.0	1,240.0	2,335.0	249.3	281.3	184.5	237.0
Wood	no data	no data	no data	89.6	81.8	57.5	98.2

Source: UPPH of DPSC, 2004.

(3) Activities carried out by other organizations or people

In Havana City, people who collect valuable materials from solid waste are referred as “buzos”, which means “skin diver”. Such types of activities are not organized at all and simply depend on individual interests.

Not only at personal level, but also at organizational level, unofficial material collection is difficult to attempt as no one can sell the collected materials to any industries or markets because of the exclusive control by the UERMP. As a result, buzos and buzo groups cannot officially exist in the City and cannot enter the provincial landfills to pick up recyclable materials.

3.3.2 Market Potential

All materials recovered in Cuba must be sold through UERMP channels. Under control of the UERMP, almost all the recovered materials have been utilized and consumed in the country. The recovered materials are utilized as described in Table 3.3.4.

In view of the existence of established routes and markets for recycling, the marketability of recyclable materials collected from MSW appears to have good prospects. The quantity from MSW would be absorbed in the market since it is a fraction of the total market demand.

Nevertheless, the feasibility of the recycling business would depend on the cost efficiency in recyclables production on the part of DPSC/UPPH.

Table 3.3.4 Utilization of Recovered Materials

Materials	Major Method of Utilization
Steel, iron, and stainless steel scrap	After processing in the raw materials recovery companies, these materials are used to make corrugated bars, beams and other metal structures in the iron and steel industry
Bronze, copper, aluminum, lead, zinc, nickel and other metals	These materials are consumed in Cuban non-ferrous foundries to make cables, profiles, carpentry items, home tools, etc.
Paper	It can replace virgin pulp in the paper industry and can be made into notebooks, boxes, tiles and other articles.
Plastic	This material is crushed and processed in the plastic industry to make new plastic containers, tanks, buckets and other utensils.
Glass containers	Containers are re-filled with drinks time after time

Source: ERMP of Havana City

3.4 Composting

3.4.1 Existing System of Composting

In Havana City, there are four main sources of organic wastes: households, commercial sector, agro-markets, and agriculture (ref. Figure 3.4.1). At present, only wastes from markets are being brought into the DPSC/UPPH composting yard.

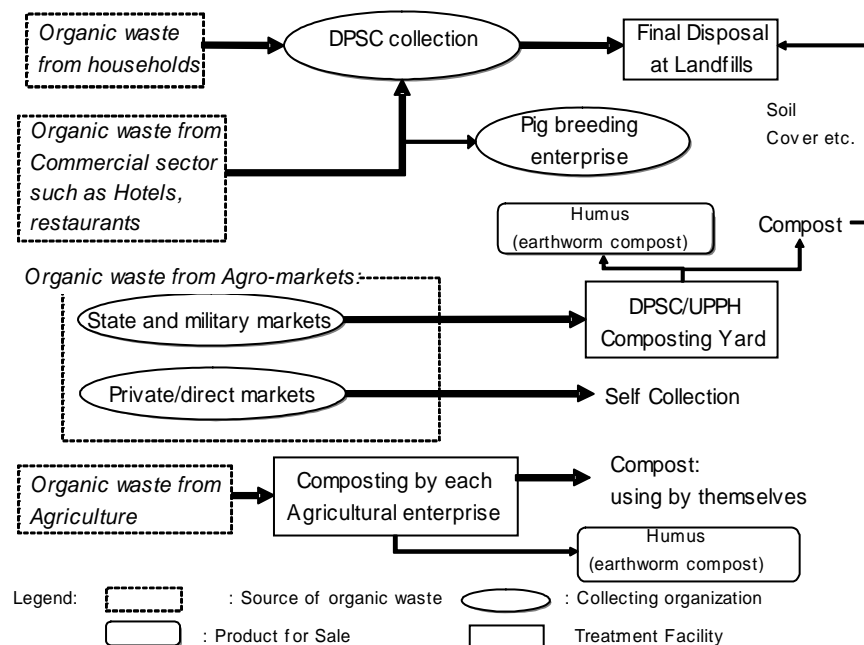


Figure 3.4.1 Existing System of Composting in Havana City

Compost made from the waste is used for soil coverage of landfill or as a base soil for plantings in the landfill sites. At the recycling center of the Calle 100 site, an effort to produce earthworm compost has been attempted, although only on a small scale. The earthworm compost is called “humus”. The project is currently progressing satisfactorily. Though the quantity is limited, compost produced from animal manure is sold to the users. The quantities of compost and humus production by UPPH are shown in Table 3.4.1.

Table 3.4.1 Production of Compost and Humus by DPSC, UPPH (2001-2004)

Recyclable Materials	2001 (m ³ /year)	2002 (m ³ /year)	2003 (m ³ /year)	2004 (m ³ /month)			
				Jan	Feb	Mar	Apr
Fermented organic waste (Compost)	500	6,534	7,019	250	250	100	no data
Earthworm compost (Humus)	60	92	164	8	6	20	no data
Total	560	6,626	7,183	258	256	120	115

Source: UPPH of DPSC, 2004.

Note: Most of the fermented organic waste is used as cover soil in landfills.

The MINAGRI is promoting urban agriculture, where a number of agricultural units produce compost and humus for their own use. Their efforts are based on their willingness to contribute to organic agriculture. They are not using MSW, but crop wastes as raw material for the compost. In 2003, around 280,000 tons of compost was produced for their own use.

There is another composting project, which is referred to as Ecopolis being promoted by an Italian NGO. Other efforts for MSWM, such as segregation and environmental education, are also components of this project.

3.4.2 Market Potential

The MINAGRI is also intensively promoting organic agriculture in the country, partly because of the difficulty of importing chemical fertilizers and also to address soil degradation problems. Almost all agricultural residues and animal manure are used for producing compost and humus by agricultural enterprises. These agricultural enterprises produce and sell humus in their shops (at a price of CUP2.50 /kg). The MINAGRI also recommends the use of other types of organic fertilizers.

According to MINAGRI, there is potential demand for organic materials for use as soil conditioner for 10,560 ha of farmland in Havana City. The amount of compost that could be consumed as organic materials for the farmland in Havana City is estimated as 529,000 tons/year.

3.5 Collection and Transportation

3.5.1 Collected Waste by Type

It was observed during the consecutive 8-day field survey conducted in March 2004 that the total collected waste was 2,313 tons as shown in Table 3.5.1, which corresponds roughly to 7,173 m³ in volume. Domestic and commercial waste was 46.5% (varying between 36% and 67%) of the daily total generated waste during the survey period.

Table 3.5.1 Collected Waste by Type Observed during 8-Day Survey in March 2004

Unit: kg/day

Type of Waste		Domestic and Commercial	Bulky waste and others	Industrial	Medical	Others	TOTAL	Total ratio	Ratio of Domestic/Commercial Wastes
Mar.9	Tue	1,384,183	796,780	253,180	22,400	291,655	2,748,198	14.9%	50%
Mar.10	Wed	972,894	823,956	459,190	5,060	392,448	2,653,548	14.3%	37%
Mar.11	Thu	1,110,990	656,690	297,330	-	191,655	2,256,665	12.2%	49%
Mar.12	Fri	1,116,015	940,390	285,030	2,770	331,680	2,675,885	14.5%	42%
Mar.13	Sat	1,150,430	603,425	284,360	-	113,703	2,151,918	11.6%	53%
Mar.14	Sun	761,065	113,420	254,160	-	8,640	1,137,285	6.1%	67%
Mar.15	Mon	1,154,724	688,010	226,550	-	148,413	2,217,697	12.0%	52%
Mar.16	Tue	947,016	975,979	208,810	-	526,840	2,658,645	14.4%	36%
TOTAL		8,597,317	5,598,650	2,268,610	30,230	2,005,034	18,499,841	100.0%	46%
Ratio		46.5%	30.3%	12.3%	0.2%	10.8%	100.0%	-	-
Ave.		1,074,665	699,832	283,576	10,077	250,629	2,312,480	-	-

3.5.2 Operation Agencies and Collection System

As described in Section 4.1, the waste collection and transportation services for Havana City is managed by three agencies: namely, UPPH, DMSC and Aurora Enterprises.

UPPH uses C/Ts to collect MSW from urban areas that generate large amounts of waste. These areas consist of residential areas with high population density and tourist, commercial, and industrial areas. Waste bins with wheels and lids are set at the curbsides so that people can bring and discharge the waste and C/T can easily access those bins. T/C and D/T operated by Aurora can enter the narrow streets in the urban areas to pick up the waste.

DMSC covers the remaining areas not served by UPPH, namely semi-urban areas having less population density. In this area, DMSC uses T/Cs, D/Ts, and H/Cs for the collection service. Collection by H/C is outsourced under contract.

Handling of bulky waste and construction waste is mainly conducted by the Aurora enterprises and UPPH. Institutions collect and transport their own waste

by D/T and other types of trucks to landfills. The operation agencies and collection systems are summarized in Table 3.5.2.

Table 3.5.2 Operation Agencies and Collection System

	UPPH	DMSC	DMSC (Contract Basis)	Aurora
Street Cleaning	By machines and manual work	By manual work	By manual work	By manual work
Collection/Transportation Equipment	C/T	T/C and D/T	H/C	T/C and D/T
Method of waste discharge and type of containers used	Bins, or waste piled up on streets	Bins, street containers, plastic bags, piled up on street	Plastic bags, other small bags, pile up on street	Street containers, pile up on street
Availability of bins	Available	Available	Not Available	Not Available
Collection responsibility area	Habana Vieja, C. Habana, Plaza, Playa, and other 3 urban municipalities	All other semi-urban areas not covered by UPPH	Rural areas	Habana Vieja and Plaza mainly, and 2 other districts for minor activity
Frequency of Collection	Daily	Daily	Daily	Daily

Notes: 1. For the required number of bins, Refer to Data Book B1.1 to B1.17: Collection and transportation plan.
2. For the type of bin, Refer to Supporting Report B2.9 to B2.10
3. For the number of collection vehicles, Refer to Supporting Report B1.1 to B1.6

3.5.3 Population in UPPH and DMSC Service Areas

The UPPH collection service covers seven municipalities in the central area of Havana City. The area covered is 145.3 km² and the population served is about 1.2 million (55% of the total population). Also, UPPH provides collection service along the main roads of four municipalities.

DMSC covers the remaining areas not served by UPPH. The area covered is 582.5 km² and has a service population of about 1.02 million (45% of the total population).

3.5.4 Estimated Quantity of Solid Waste for Collection by UPPH and DMSC

The total quantity of domestic and commercial waste covered by the UPPH and the DMSC was estimated to be about 940 tons/day in 2004 as shown in Table 3.5.3. The amount of domestic and commercial waste collected by the UPPH amounts to 75% of all waste collected by public services while the rest is collected by DMSC. The quantity of bulky waste collected by DMSC is estimated as 567 tons/day.

The above quantities represent the majority of total waste generation from the City shown in Table 3.5.1.

In addition, the record of Aurora's activity in 2003 shows that Aurora Plaza annually collected 567,700 m³ and Aurora Havana Vieja was 321,306 m³ (ref. Data Book D). If the bulk density is assumed to be 150kg/m³, total waste collected these two Auroras was, in weight, about 133,400 tons per year, or 365 tons per day.

Table 3.5.3 Quantity of Waste Collected by UPPH and DMSC

Unit: tons/day

Type of Waste	UPPH	DMSC			Total
		H/C	D/T	T/C	
Domestic and Commercial Waste* (%)	703 (75%)	75 (8%)	81 (9%)	81 (9%)	940 (100%)
Bulky and other waste	0	0	567**		567
Total	703	75	729		1,507

Source: Eight day field survey conducted by the Study Team and UPPH in March 2004.

Note: * These values for domestic and commercial waste were based on actual measurements of mixed waste at the surveyed landfill sites and by estimation at SPLs.

** The bulky and other waste consists of construction waste, yard waste, trees, and branches. This amount fluctuates by season, and 567 tons is assumed to be rather high because the survey was conducted at a time when branches are commonly cut ahead of the summer hurricane season.

3.5.5 Unlawful Dumping of Wastes

A not negligible quantity of waste is disposed of unlawfully over wide parts of the City. Along the Quibu River and other small rivers in the coastal area, unlawfully disposed waste floats down into the sea and spreads along the seashores. This creates another environmental issue in the City.

UPPH cleans up the waste once every three to four months at sites that have become visually unpleasant and at those locations requested by the public.

3.6 Disposal of the Solid Waste

3.6.1 Existing Landfill Sites

Presently there are 14 landfill sites in Havana City. Among them, three are provincial landfill² sites, namely, Calle 100 landfill, Guanabocoa landfill, and Ocho Vias landfill. One is a municipal landfill³ site, namely Barreras landfill. In addition to those 4 landfill sites, the other 10 sites are so called 'special period landfill (SPL)' sites, which are controlled and managed by the respective communities under the municipality's control. Special period landfills were built as temporary landfills to cover the shortage of capacity of the provincial and municipal landfills.

² Provincial landfill: Operation of landfill is conducted by the local municipality

³ Municipal landfill: Operation of landfill is conducted by DPSC and UPPH

Whereas the provincial landfills collect the waste from a wide area, Berreras municipal landfill receives waste only from Habana del Este municipality, and the special period landfills collect waste from the area around each landfill (5-10 km range). All the landfills accept MSW and the provincial and municipal landfills accept bulky waste too. Among the provincial and municipal landfills, only Ocho Vias accepts industrial waste.

The major features of the landfills are shown in Tables 3.6.1 and 3.6.2, and their locations are shown in Figure 3.6.1. It is noted that Guanabacoa landfill was closed by DSPC in March 2005 despite having a remaining disposal capacity equivalent to a further 6 years of operation. According to DSPC, the reason for the closure is complaints from the neighboring residents about bad smells and the scattering of plastic bags from the landfill.

Table 3.6.1 Conditions of Existing Provincial and Municipal Landfills as at 2004

Item	Provincial Landfill			Municipal Landfill
	Calle100	Guanabacoa	Ocho Vias	Barreras
Location (name of municipality)	Marianao	Guanabacoa	Cotorro	Habana del Este
Disposal site area (ha)	104	28	30	10
Max. disposal capacity:				
(1000 m ³)	12,800	3,920	4,730	720
(1000 tons)	5,020	1,200	1,140	170
Accumulated disposal volume:				
(1000 m ³)	11,580	2,680	2,520	370
(1000 tons)	4,540	820	610	90
Expected remained life (Year)	1.9 years	6 years	10 years	More than 10 years
Service commencement year	1976	1976	1976	1975
Receiving waste volume (tons/day)	1,692	354	353	46
Type of waste	MSW	MSW	Industrial Waste	MSW
Operation equipment	Bulldozer:3, Truck:1	Bulldozer:1	Bulldozer : 1	Bulldozer : 1
Management organization	DPSC	DPSC	DPSC	Municipality
Numbers of personnel	56	30	36	3
Future plan of alternative landfill after the closing	New Dumping Site for MSW	New Guanabacoa	New Dumping Site for Industrial	No plan

Note: Survey of number of vehicles was conducted by visual inspection and recorded in each landfill site.

Table 3.6.2 Current Conditions of Existing Special Period Landfills as at 2004

Item	Campo Florido	El Vidrio	Prensa Latina	Rincon	Lugar dita	Las Canas	Guasmas	Fraternidad	Elcrrico	Cant.Los Perros
Location (Name of municipality)	Hab. Del Esta	La Lisa	Boyeros	Boyeros	Boyeros	Boyeros	Arroyo N.	Arroyo N.	Arroyo N.	Cotorro
Collection area (km ²)	79.65	9.86	40	36.66	14.33	21.7	39.87	18.44	17.91	54.9
Service population	9,240	57,665	32,674	53,951	24,725	23,775	14,150	109,779	30,785	66,524
Disposal site area (ha)	3.2	2.5	2.0	0.5	1.5	1.0	2.0	2.0	0.5	2.0
Max. disposal capacity: (1000m ³) (ton)	9 900	119 11,900	133 19,600	48 4,800	43 4,200	29 2,800	29 2,900	57 5,700	33 3,800	285 46,200
Accumulated disposal Q'ty: (1000m ³) (ton)	7 700	86 8,600	97 14,300	36 3,600	31 3,100	19 1,900	15 1,500	33 3,300	21 2,500	216 35,100
Service commencement year	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990
Receiving waste volume (tons/day)	0.9	12	15	4.9	3.7	2.6	2.1	5	2.8	30
Type of waste	MSW	MSW	MSW	MSW	MSW	MSW	MSW	MSW	MSW	MSW
Operation equipment	none	none	none	none	none	none	none	none	none	none
Management organization	Community	Community	Community	Community	Community	Community	Community	Community	Community	Community
Numbers of personnel	2	2	2	2	2	2	1	6	4	1
Future plan of alternative landfill after the closing	Municipal, provisional landfill	Calle 100	Calle 100	Calle 100	Calle 100	Calle 100	Calle 100	Calle 100	Calle 100	Calle 100

Note: Survey of number of vehicles was conducted by visual inspection and recorded in each landfill site.

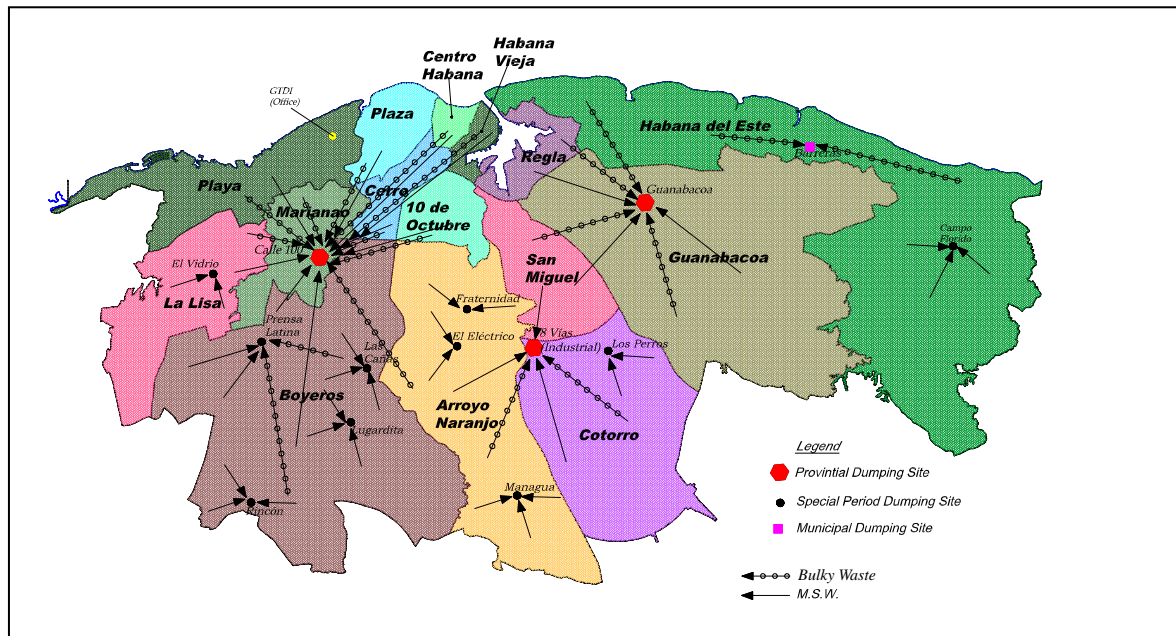


Figure 3.6.1 Location and Collection Area of Each Landfill (2004)

3.6.2 Waste Disposal at Landfill

It was observed that the existing landfills caused a number of environmental problems including wind-blown litter, generation of bad odors, vermin, and soluble contaminant impacts (leachate) leaching into and polluting ground water. None of the existing waste disposal sites are a sanitary landfill type. None use a liner system, collect or treat leachate or vent landfill gases.

At the provincial and municipal landfills, waste is unloaded on the ground by transportation vehicles at the top of the waste disposal place and pushed down the slope by a bulldozer. A soil covering is applied occasionally, but not always.

As the soil covering is not sufficient, plastic bags and papers are scattered everywhere and spontaneous combustion often occurs. Residents in the neighboring areas strongly complain about the landfill sites and push to have DSPC improve or close them. Waste picking activities are prohibited at the landfill sites in Cuba.

3.7 Maintenance Workshop

UPPH and DMSC have maintenance workshops for the ordinary repair and maintenance of collection vehicles and heavy equipment. Figure 3.7.1 shows the location of those workshops.

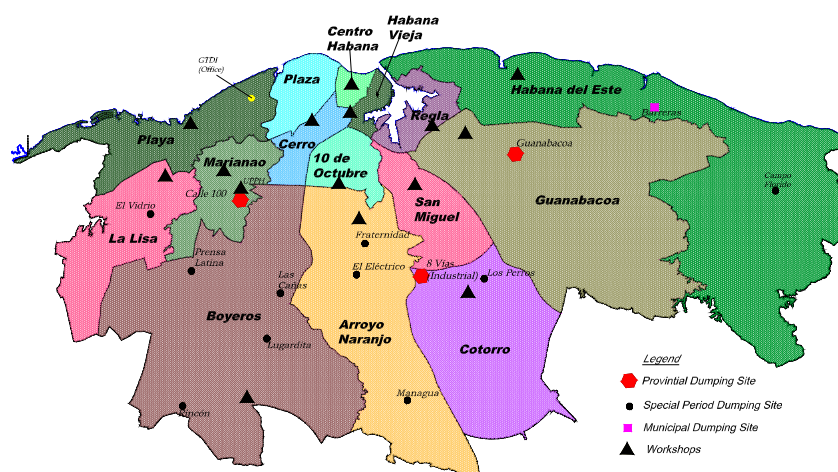


Figure 3.7.1 Location of Maintenance Workshops

3.7.1 Outline of Workshops

(1) UPPH

UPPH has one workshop for the vehicles located alongside their main office and one workshop for the heavy equipment in Calle 100 landfill. In addition, UPPH has two mobile workshops although one is currently out of order.

Among a total of 517 employees of UPPH, 170 engineers, technicians and skilled workers are working in the maintenance sections.

Maintenance items are summarized in Table 3.7.1 and the major facilities and equipment of the workshops are shown in Table 3.7.2.

The major types of work undertaken at the workshops are overhauling engines, adjustment of engines and replacement of broken parts. However, due to a shortage of instruments, tools and spare parts, adjustment and assembling are not done correctly, and the use of parts with different specifications from broken-down vehicles results in failure of the repairs. The poor performance of the workshops mainly comes from the breakdown of tools and equipment and shortage of spare parts rather than any lack of capability of the employees. Overall, UPPH has more than 28 years experience in maintenance work, so it has gained sufficient technical capability to maintain and keep its equipment operating efficiently. In general, employees have sufficient experience in the field of maintenance work for collection vehicles and related equipment.

Table 3.7.1 Lists of Major Maintenance Items

Items	Description	Responsible Section	Required time
Morning checkup	Oil/ fuel, brakes, lights, water level, battery, steering, air pressure, general observation, tightening tire lugs, etc	Technical section and all related sections	7 - 10 minutes
Maintenance depending on km operated	Type 1 to 3 depending on running km: check items were adopted from manufacturers' recommendations.	Technical section and all related sections	-
Monthly checkup	Hydraulically-operated parts, leaking water/oil, viscosity of lubricant, air pressure, water, battery, gauge/level, confirmation of performance of exchanged parts, tightening tire lugs, etc.	Central Workshop	1 - 2 days depending on availability of parts
Annual inspection	To obtain vehicle registration: Check items follow the legal requirements.	Ministry of Transportation	-
Most common maintenance items	1) Repair and adjustment of hydraulically-operated parts 2) Replacement of suspension springs 3) Repair flat tires 4) Repair engines	Central Workshop	1 - 2 days depending on availability of parts and kinds of repair
Recording of fuel consumption (diesel)	Presently consumption: About 31,000 liter/day for 90 vehicles	Technical section	-

Table 3.7.2 Major Facility and Equipment of Workshops for Vehicles of UPPH

Items	Quantity	Description
1.Workshop facility		
Parking area	10 ha	200 units at maximum
Bin assembly / Stock yard	1	Stock 200 to 300 bins (as at Feb. 2004)
Parts stock room	2	Problem is insufficient number of parts
Offices/Buildings	8	Administration office, staff office, etc.
Dining room	6	-
Lavatory	11	-
Shower room/Rest room	3	-
Fuel filling station	3	Oil tanks and fueling equipment for diesel
Vehicle repair yard/Workshop	3	-
Water tanks	13	-
Tire repair equipment	3	For dump trucks & all types of vehicles
Machine tools room	2	Only limited number of tools are in stock
2.Equipment		
Lathes	3	Equipment is in deteriorated condition
Drill	1	Equipment is in usable condition
Electric welding equipment	1	Equipment is in deteriorated condition
Gas welding	2	-
Grinder	1	-

(2) DMSC

DMSCs have 14 workshops, one in each municipality except Plaza Municipality. About 150 of DMSC's 1,630 employees are involved in maintenance work. They are conducting similar maintenance works to those conducted by UPPH. However, the shortage of tools and spare parts in DMSC's workshops is more severe than in the UPPH workshops. Even the repair of tire punctures cannot be done within an adequate time depending on the availability of repair parts and tools in each workshop.

The ability of the maintenance workers seems to be generally high, but the performance of maintenance works is restricted by the availability of tools and spare parts, just as for the case of the UPPH workshop.

3.7.2 Operation Conditions of Workshop

As described above, the UPPH and DMSC workshops are suffering from a shortage of repair equipment, tools, and spare parts, which appears to restrict the operation ability. Table 3.7.3 shows the items of shortage expressed by respective workshops of UPPH and DMSC during the Study. As shown in the table, almost all the workshops face shortages of almost all the items.

Table 3.7.3 List of Maintenance Equipment Requested by DMSC & UPPH

MUNICIPAL	Flat Tire Repair Equipment		Machine tool			Parts			Tools/etc	Engine Test Equipment	Battery Liquid & Test Kit
	Small	Big	Lathe	Electric /Gas Welding	Electric drill	Tires	Car Components	Parts of a machine			
DMSC	PLAYA	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
	PLAZA	No	No	No	No	No	No	No	No	No	No
	CENTRO HAB.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	HAB. VIEJA	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	REGLA	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	HAB. ESTE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Guanabacoa	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	SAN MIGUEL	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	10 OCTUBRE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CERRO	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	MARIANAO	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	LISA	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	BOYEROS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ARROYO N.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
COTORRO	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
UPPH	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Data source: UPPH

The shortage of equipment and materials directly impacts on the operating rate of the vehicles. Table 3.7.4 shows the conditions of C/T owned by UPPH as of January 2005. More than 50% are out of operation, including ones scheduled to be scrapped. Major types of damage to vehicles under repair are engine failures, punctures, oil leaks, and malfunctions of hydraulic systems, transmissions, springs, lamps and brakes. Most of the damages are repairable if repair equipment and parts were available.

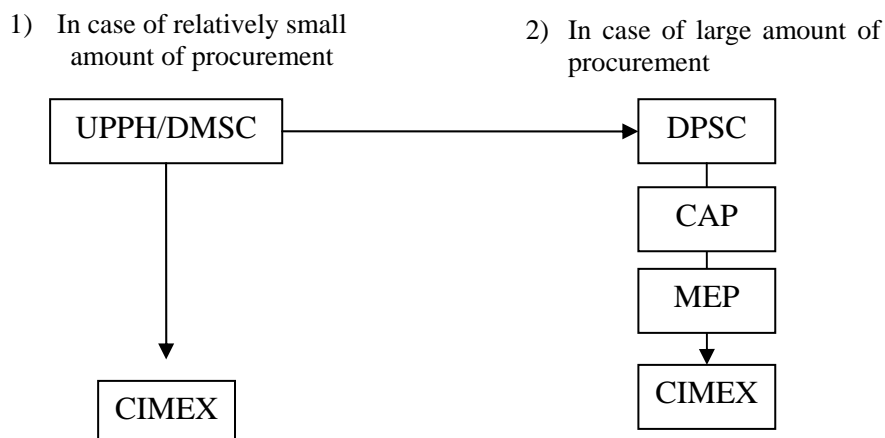
Table 3.7.4 Conditions of Vehicles (C/T) Owned by UPPH
As of January 2005

Description	Conditions of Vehicles (C/T)		
	In Operation	Out of Operation	Total
Number of Vehicle Units	40	25	65
%	62	38	100

Source: UPPH 2004

3.7.3 Purchase Conditions of Vehicles and Parts

The replacement of vehicles and purchasing of parts are essential requirements of maintaining normal waste management operations. Officially, when purchasing new vehicles and/or parts, UPPH and DMSC must follow the purchase procedures shown in Figure 3.7.2. UPPH and DMSC need to obtain permission for purchases from CAP through DPSC. However, as UPPH and DMSC have to make budget provisions before requesting the approval, this procedure hardly works under the current conditions.



Note: CIMEX: Name of the Cuban Organization that Imports and Exports the Goods

Figure 3.7.2 Procedure for Purchases by UPPH/DMSC

Since both the UPPH and DMSC have not had enough financial resources for the last four years, they have no spare parts in stock in the workshops. In fact, spare parts are extracted from scrapped vehicles.

3.8 Framework of Environmental and Social Considerations

(1) Items to be considered for environmental issues

According to the Environmental Law in Cuba, environmental consideration is to be given in consideration of various provisions designated in the following regulations and plans:

- National environmental strategy, the national program of the environment and development, and other economic and social development programs, plans and projects
- Environmental law, its complimentary provisions, and other legal regulations intended to protect the environment, including technical standards for environmental protection
- Environmental land-use planning
- Environmental license
- Environmental impact assessment
- Environmental information system
- Environmental education
- State environmental inspection system
- Scientific research and technological innovation
- Economic regulation
- National environmental fund

- The regimes of administrative, civil and penal liability

As shown above, the items cover strategy and legal framework, environmental impact assessment, social awareness, monitoring, technological aspects, economic and financial aspects and institutional framework for environmental consideration. Havana city has prepared the City's policy for environmental considerations following the above national policy.

(2) Legal system for environmental consideration

The prime law for environmental consideration in Cuba is the "Environment Law" enacted in 1997. The Law consists of the "institutional framework", "environmental policy and administrative measures" and "environmental issues".

Including the Environmental Law, Table 3.8.1 shows other relevant laws and regulations addressing environmental considerations in Cuba.

Table 3.8.1 Main Laws Addressing Environmental Considerations

No	Name in Spanish	Name in English	Date of Enactment
1	Ley 81 del medio ambiente	Environment Law	11-07-1997
2	Decreto-Ley 200 De las contravenciones en materia de medio ambiente	Decree of penalty on environment	22-12-1999
3	Decreto 179 Protección, uso y conservación de los suelos y sus contravenciones	Decree of soil conservation	02-02-1993
4	Decreto 199 Contravenciones de las regulaciones para la protección y el uso racional de los recursos hidráulicos	Decree of water-resources conservation	10-04-1995
5	Resolucion 130-95-CITMA Reglamento para la inspección ambiental estatal	Regulation of national environmental inspection	01-06-1995
6	Resolucion 168-95-CITMA Reglamento para la realización y aprobación de las evaluaciones de impacto ambiental y el otorgamiento de las licencias ambientales	Regulation of environmental impact assessment	15-09-1995
7	Resolucion 77-99-CITMA Reglamento del proceso de evaluación de impacto ambiental	Regulation of environmental impact assessment procedure	28-07-1999

(3) Organizations responsible for environmental consideration

CITMA is the central governmental institution responsible for environmental considerations in Havana City. It manages environmental issues in Havana City, prepares regulations and standards on the environment, and judges the results of environmental investigations.

In addition, the following institutions are also responsible for environmental considerations on specific subjects:

- Institution of Water Resources (INRH): manages water resources, water supply, and the sewerage system.
- MINSAP: manages public health and epidemiological conditions
- MINAGRI: manages forest resources and vegetation.

(4) Present environmental monitoring activity

1) Organization responsibility for environmental monitoring

Periodic monitoring of climate and air quality has been conducted in Havana City. However, for the last five years, the monitoring of other items has been inadequate because of a lack of supplies such as equipment and reagents for chemical analysis.

Table 3.8.2 shows the outline of the environmental monitoring in Havana City.

For landfills, environmental monitoring itself has not been conducted sufficiently and there is presently no data to grasp the environmental condition in and around the landfills.

In order to rectify the situation, DPSC has established a laboratory to conduct the sampling and analysis of solid waste, leachate and air quality. There are 30 staff members including eight specialists. Some equipment was installed in the laboratory as shown in Table 3.8.3.

Table 3.8.2 Outline of Periodic Environmental Monitoring in Havana City

No.	Environmental Aspects	Monitoring Items	Monitoring Points	Monitoring Frequency	Responsible Agency
1	Climate	Temperature, precipitation, humidity, wind velocity, wind direction	2 points (Casablanca and Santiago de las Vegas)	Continuous monitoring	Institute of Meteorology
2	Hydrology	River water level	By Water Basins	Mostly on a daily basis	INRH
3	Biodiversity	Fauna, flora, rare species	*1	*1	Institute of Ecology and Systematics
4	Air quality	pH,NO ₂ ,NO _x ,NH ₃ ,SO ₂	2 points (Casablanca and Santiago de las Vegas)	Continuous monitoring	Institute of Meteorology
5	Water quality	physical, chemical and bacteriological analyses	Not informed	Not informed	*2
6	Noise and vibration	Noise	*1	*1	MINSAP (Hygiene and Environmental Health)
7	Soil contamination	Phosphorous, calcium, magnesium and others	*1	*1	MINAGRI

Note *1: There are no periodic monitoring points due to the lack of equipment and financing in general. Although monitoring is not conducted at sufficient frequency, it is achieved to some degree through projects under Environment Fund (UN) and CITMA (Ministry) financing.

*2: In Havana Bay, a Government working group monitors and analyzes the condition of Havana Bay and its surroundings through CIMAB. Ocean water quality is monitored by the Institute of Oceanography, the Ministry of Fishing and the Marine Research Center. Besides, there is a resolution for the coastal zone, Decree No. 212/2000

Source: CITMA

Table 3.8.3 Equipment installed in DPSC Laboratory

No	Name of Equipment	No. of Equipment	Testing Items
1	JENWAY PFP7 Flame photometer	1	Na, K, Ca, Ba, Li
2	HACH DR/4000U Spectrophotometer	1	COD, DO, TOC, Nitrogen, Phosphate, Chloride, heavy-metal, others (total :63items)
3	BUCHI K-314 and k-424 Nitrogen Determination	1	Nitrogen
4	Balance	2	Weight
5	pH meter	1	pH
6	Conductivity meter	1	Conductivity
7	WTM Turb550	1	Turbidity
8	Thermosphere	2	-
9	Water bath	1	Temperature 20~90°C

2) Relevant standards

The following national standards exist for environmental monitoring.

- Water – NC 27/99 regarding discharge of sewage to the surface water and sewerage systems.
- Noise – NC 26/99 regarding noise in inhabited zones, hygienic-sanitary requirements.
- Soils – NC 209/2002 regarding soil quality, determination of anions and cations.

A national standard for air quality is now under preparation and will be issued soon (the issue date is unknown).

To plan a leachate treatment system, standard values of leachate and leachate discharge quality are necessary. However, there are no leachate discharge standards in Cuba.

Table 3.8.4 shows the water quality standards for effluent discharged into inland surface waters. These standards will be referred to in planning the treatment of leachate at landfill sites.

Table 3.8.4 Water Quality Standards for Effluent Flowing into Inland Surface Waters, NC27

Parameter	Receiving Waters								
	Rivers and Dams			Partial Saturation Area			Saturation Area		
	A	B	C	A	B	C	A	B	C
pH	6.5-8.5	6-9	6-9	6-9	6-9	6-10	6-9	6-9	6-10
Temperature	40	40	40	40	40	50	40	40	40
Conductivity	0.14	0.20	0.35	0.15	0.20	0.40	0.15	0.20	0.40
BOD5	30	40	60	40	60	100	30	50	100
COD	70	90	120	-	-	-	-	-	-
Total nitrogen (T-N)	5	10	20	5	10	15	5	10	15
Total phosphorous (T-P)	2	4	10	5	5	10	5	5	10
Oil and grease	10	10	30	5	10	30	ND	10	20
Floatable solids	ND	ND	ND	-	ND	ND	ND	-	ND
Settleable solids	1	2	5	1	3	5	0.5	1	5

Class (A): Rivers, dams and hydro-geological zones used for the collection of water for public and industrial use for food elaboration. The classification comprises the water bodies located in prioritized zones of ecological preservation.

Class (B): Rivers, dams and hydro-geological zones where waters are collected for agricultural irrigation, especially where there are crops that are consumed raw, where there are aquaculture and recreational activities in contact with water, and where water bodies exploited for industrial use in processes that need water quality requirements. The classification involves the sites where there are less strict requirements for the ecological preservation than those of Class (A).

Class (C): Rivers, dams and hydro-geological zones of lesser value from the usage aspect such as: navigation waters, waste water irrigation, factories not very exigent with the quality of the water to be used and, irrigation of crops tolerant of salinity and excessive content of nutrients and other parameters.

ND: Not determined

(5) Environmental impact assessment (EIA)

Development, expansion and modification of projects in Cuba require acquisition of an environmental license through the procedure for environmental consideration. The procedure includes land use planning (planning from an environmental viewpoint), location approval, and an environmental impact assessment. In addition, the preparation of an environmental monitoring plan is required before beginning the construction and operation of the project.

Consultation for detailed location, the decision to issue the environmental license, and preparation of the monitoring program are conducted by CITMA at the central level and by the local government at the municipal level. The feasibility survey and environmental impact assessment are conducted by CIMTA and other organizations such as environmental consultant companies.

The Environmental Law defines environmental impact assessment as “a process whose object is to avoid or mitigate undesirable environmental effects resulting from plans, programs, projects or activities through a prior estimation of the environmental changes caused by such projects or activities and, in appropriate cases, the denial of permits necessary for execution of those acts, or their approval with specific conditions”. It shall include detailed information about the monitoring and control systems required to ensure compliance and about the necessary mitigation measures that should be considered.

For the solid waste sector, the EIA process is required for d) facilities for the management, transportation, storage, treatment, and final disposal of hazardous waste and u) sanitary landfills.

The process of EIA is divided into four phases:

- (i) the application for an environmental license
- (ii) the environmental impact study, where required
- (iii) the evaluation of environmental impacts
- (iv) the granting or denial of the environmental license

The processes of (i) to (iii) and (iv) are conducted by CITMA and (ii) by a consultant company.

The result of an environmental study should be reported based on the guidelines prepared by CITMA (Guide for the application for an environmental license and environmental impact studies, CITMA, 2000). According to the guidelines, the report for an environmental impact study should include:

- 1) Executive summary of the environmental impact study
- 2) Complete description of the project

- 3) Description of the environmental base line
 - 4) Identification and analysis of the impacts
 - 5) Preventive and correcting measures
 - 6) Monitoring plan during the construction, operation and definite closing up stages
 - 7) Public consultation.
- (6) Social Considerations
- 1) Involvement of the population

MSWM is an issue that affects the population in three different ways:

- As clients of a basic public service
- As actors that can contribute to improvements in the system
- As being affected by negative impacts

Each of these aspects calls for the population's involvement, though in different ways. As clients, people are entitled to expect a satisfactory quality of service being provided to them; in this case, adequate collection of their domestic waste and a clean living environment. This requires service improvement regarding the existing system. As actors, the population is to be seen as part of the solution to the problems related to MSWM. Through changes in attitude, they can contribute positively to a better MSWM system, particularly by separating, reducing and reusing their waste and depositing the waste in appropriate locations. To assist in this, awareness-raising and active participation are of the utmost importance.

Being affected by negative impacts, specifically those related to the landfills, people have a right to have their position considered in the planning and operation of landfills to reduce the negative impacts suffered by the surrounding population to a minimum. The reduction of negative impacts is an important aspect of any MSWM system.

2) Social considerations in EIA

Another important tool regarding the minimization of social impacts is environmental impact assessments (EIA). An EIA is required in order to consider the impacts of any activity on the population, which is considered by the legislation as being a part of the environment.

Environmental impact assessments are required by law for new landfills as well as old ones that are being used. Resolution No. 77/99 (chapter III, article 23, paragraphs a, c and g) clearly states that the following social issues must be considered in an EIA:

- a) Health risks to the population, due to the quantity and quality of effluent, emissions or residues and noise;
- b) Resettlement of local communities, or alterations in the way of life and habits of groups of people;
- c) Results of public hearings.

Article 4 of Law no. 81 “on the principles on which the environmental actions are based” explicitly contains the three basic principles established by the Rio ‘92 Declaration: i.e., the right to 1) access to information, 2) participation, and 3) justice.

3) The right to access to information:

Paragraph (e): Every person must have adequate access, in accordance with what is established by law, to the information on the environment held by state organizations and institutions.

4) The right of participation:

Paragraph (k): The public knowledge on environmental acts and decisions and consultation with citizens shall be guaranteed by the best possible means, but in any case should be considered indispensable.

Paragraph (m): The role of society is essential to accomplish the objectives of this law; this involves effective public participation in decision-making and the development of self-management processes focusing on environmental protection as well as the improvement of the quality of life of the people.

5) The right of access to justice:

Paragraph (l): Every individual and legal entity, in accordance with their legally granted attributions, must be able to count on adequate and sufficient means to act administratively or judicially, as applicable, to demand the fulfilment of what has been established by this law and its complementary regulations.

The main mechanism of an EIA to directly involve the population is constituted by public hearings. This serves two purposes: firstly to inform the members of society, and secondly to respond to their opinions and concerns.

In order to guarantee the effective representation of society as a whole, the following actors in particular should participate in the public hearings:

- The competent authority

- The investor
- Key social stakeholders
- Other stakeholders
- Experts

Relevant information regarding the public hearing includes:

- Context and general characteristics of the project
- Pros and cons
- Possible positive and negative impacts, both direct and indirect, reversible and irreversible
- Plans for mitigation measures regarding undesired consequences, including budget
- Judicial procedures regarding compensation

Acceptance of the Project will be dependant on the following basic variables:

- Knowledge of the general characteristics of the project
- Knowledge of the positive and negative aspects
- Knowledge of the proposed mitigation measures
- Social acceptance of the project
- Capacity to identify and suggest modifications to the project

Following these procedures, an EIA takes into account the social aspects of the proposed projects.

3.9 Awareness-raising

(1) Awareness of the citizens

The awareness survey indicated that a large majority of the population (82%) is aware of the fact that there are serious problems facing MSWM in Havana City. CITMA received many claims of environmental pollution from the residents that live adjacent to landfills, and the existing Guanabacoa landfill and the other three Special Period Landfills consequently closed in March 2005. Despite this, only 66.7% of people living close to landfills are aware that there is a problem. The most plausible explanation for this might be that these people have been accustomed to inadequate collection and disposal for a long time. Near the landfills, waste is collected by tractors and horse carts with less use of containers (only 7% of households, against an average of 53%), which often causes inadequate collection of waste. This make the people consider the present situation as normal.

On the contrary, people in other parts of the City observe daily many broken containers and litter scattered around them, which are obvious signs of the system in crisis. It might also be the case that there is a difference in the level of education between the different areas, and this may be leading to different perceptions. In contrast with the general level of perception of the problem, the extent of dissatisfaction about the way in which waste is collected is much larger in the immediate surroundings of landfills (only 44.4% of people are satisfied near landfills against 70.3% on average).

A larger portion of the population than those recognizing the problem is prepared to contribute to its solution (91.3%). This fact is very positive with regard to the necessity of convincing people to participate.

Practically all interviewees are already involved in some type of re-utilisation and recycling of part of their garbage, and 77.8% are already prepared to systematically separate their MSW. A different level of motivation was identified between the average population and those living near landfills. The latter seem to have a more profound conviction of the necessity for re-utilisation and recycling.

Although less than half of the interviewees had ever heard about compost (44.5%), most said they would be willing to use it after it was explained to them. A huge difference was registered, however, between residents near landfills and those living some distance away in terms of willingness to become involved in home composting. Of those living nearby, 74.1% were interested, against only 47.7% living further away.

From this it can be concluded that there is already quite a high level of awareness, both of the general problem and of possible solutions. Also, the willingness to participate can be considered high. This implies that awareness-raising campaigns should focus on educating people on how to participate, rather than convincing them to do so.

(2) Experiences of organisations in awareness-raising activities

Many organisations are involved in some kind of activity related to environmental education and awareness-raising. Most of this is done through the government agencies responsible for education and environment, with CITMA being the most important. CITMA coordinates two networks, the Environmental Training Network and the Awareness-raising Network. These networks were discussed in Subsection 3.9 (3) in more detail.

The DPSC has people responsible for environmental education and awareness-raising in all of its units. However, little attention has been paid to the execution of an effective strategy. More guidance and/or motivation will be needed for encouraging the activities.

(3) Examples of Participation of Citizens in Similar Projects

There is no structural involvement of citizens in MSWM in Havana City. Some participation and awareness-raising has occurred in some specific projects, which include:

- Agenda 21;
- Urban Agriculture Project;
- Havana Ecópolis.
- Havana Bay Project

Agenda 21 is a worldwide initiative that resulted from the 1992 Conference on the Environment in Rio de Janeiro. Worldwide, countries initiated the processes in which all sectors of society were represented to jointly define strategies to achieve sustainable development. Initially, these processes were activated at the national level, but subsequently they have reached lower administrative spheres, and in many places in the world today provinces and municipalities are in the process of developing their own Agenda 21.

The Urban Agriculture Project is a local initiative in which small plots in urban areas are used to produce food crops. The plots are often affected by litter, which is considered a major problem. It might also be interesting to involve this project in the small-scale production of compost proposed in this Study, as these two projects would complement each other very well.

An Italian NGO linked to the University of Florence is developing a participatory project called Havana Ecópolis in the municipality of Marianao in collaboration with DPSC. Activities include, for example, waste collection and recycling as well as local awareness-raising. The population participating in the project actively separates recyclables, which are then sold to the State Raw Material Company. It would be very important for this Study to learn from the experiences of this project and to incorporate successes when formulating new projects. As far as the sale of recyclable materials is concerned, the experience will have proved a valuable experience for individual citizens.

The Havana Bay Project, which was elaborated by CITMA and implemented by the Task Force for the Bay of Havana with funding by JICA, was an effort to clean the Havana Bay from pollution, including garbage. This project included an

education and awareness-raising component. Being provided with sufficient funding, the project has achieved satisfactory results and serves as an example to many similar projects.

In conducting the awareness-raising activities for the proposed MSWM, DPSC/UPPH and DMSC can learn various aspects from the experiences in these projects.

3.10 Industrial and Medical SWM

3.10.1 Industrial SWM

(1) General

In Havana City, the collection and disposal of industrial solid waste generated by factories shall be carried out under the responsibility of the factories themselves according to the regulations established by the Government.

UPPH and Aurora Enterprises transport industrial waste on a contract basis, but this is limited to non-hazardous waste. It is estimated that they transported about 350 tons/day of industrial waste on average in 2004.

The overall management including the inspection of industrial waste is conducted by CITMA.

(2) Related laws and regulations

Industrial SWM in Havana City is carried out based on the following laws and regulations issued by the concerned governmental authorities:

- Law No. 81: Environment Law, 1997
- Resolution 77/99: Environmental Impact Assessment
- Cuban standards issued by the national standardization office: NC 37

(3) Types of industries

According to the statistics report issued by the Government, industries operating in Havana City are classified into the categories shown in Table 3.10.1.

Table 3.10.1 Type of Industries in Havana City

No.	Type of Industries
1	Fuel industry
2	Mining and ferrous metal industry
3	Chemical industry
4	Paper and cellulose industry
5	Graphic industry
6	Building materials industry
7	Glass and ceramics industry
8	Textile industry
9	Garment industry
10	Foodstuff industry
11	Fishing industry
12	Alcohol and tobacco industry

Source: Statistics report issued by the Government of Cuba

(4) Quantity of industrial waste

The survey procedures carried out by the Study Team concerning industrial waste in Havana City consisted of the following:

- Questionnaire survey of 15 selected factories
- Monitoring and inspection of Calle 100 and Guanabacoa landfills
- Review and analysis of the data prepared by DPSC/UPPH

As a result, it was estimated that the amount of industrial waste generated in Havana City is around 350 tons/day.

(5) Reuse and recycling of industrial waste

The best way to reduce waste is to reduce the quantity of waste generated at the source, an approach known as source reduction. Waste reduction or minimization includes activities such as reuse and recycling by directing the return of waste into the production process stream or other alternative purposes, thus leading to both economic and environmental benefits.

According to the data issued by CITMA in 2003, which gives information on 34 factories in Havana City that generate industrial waste, most of the factories utilize the waste as raw material or recycle it at their premises. Some factories sell the waste or generated materials to other factories.

(6) Current industrial waste management system

In Havana City, collected industrial waste is basically disposed of in the Ocho Vias landfill based on the regulation issued by DPSC. However, a part of the generated industrial waste is disposed of in other landfills by the generators. Some of the food waste generated in large-scale food factories is utilized as a resource

for composting. Basically, almost all waste discharged from industries is managed by each company (enterprise) themselves.

Hazardous waste is treated by each factory based on Government regulations. Some of the hazardous waste generated in the factories that are designated by CITMA is transported to a storage yard in Casablanca town. Non-hazardous municipal waste is transported to landfills by UPPH and Aurora Enterprises. Disposed ferrous and glass materials are collected by the operational staff and utilized as resources for recycling. These materials are sold directly to UERMP and Combinado del Vidrio, respectively.

Presently, the following equipment is utilized for the transportation of industrial waste:

- Compacter trucks supplied by UPPH and operated by Aurora Enterprises
- Large type containers (8 m³ type cart)
- Conventional trucks, such as dump trucks (e.g. ZIL-130)

The flow of industrial waste is shown in Figure 3.10.1.

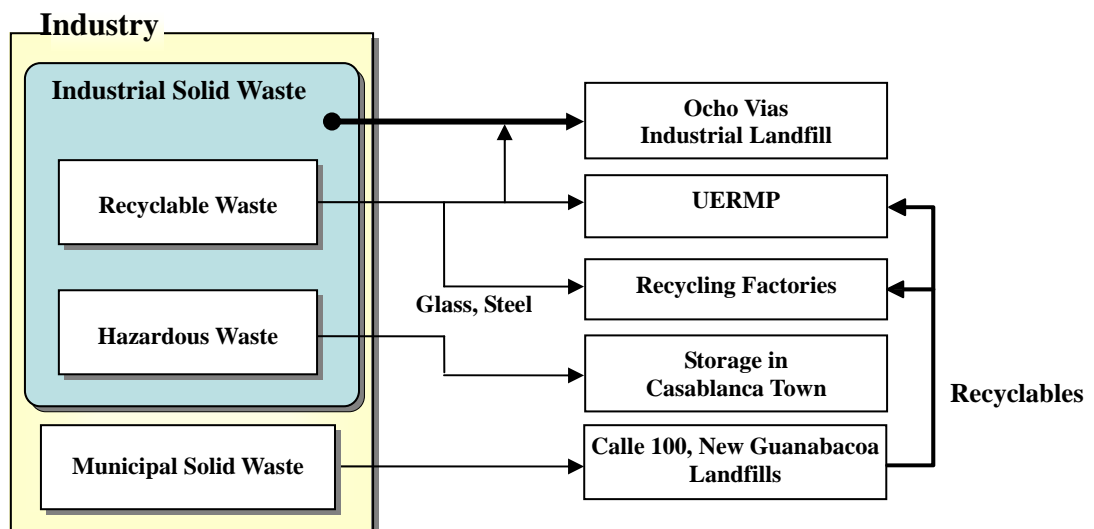


Figure 3.10.1 Flow of Industrial Waste

3.10.2 Medical SWM

(1) General

In Havana City, the MINSAP is responsible for enforcing the management of medical waste as well as for health-care administration at the central level while the provincial public health authorities are responsible at the city level for all aspects of health-care, including hospital management. Health-care facilities are under the control of delegates of the MINSAP in Havana City.

Thirty five incinerators have been installed in the different hospitals for the treatment of a part of the medical waste generated in hospitals.

(2) Related laws and regulations

Medical waste management in Havana City is being carried out based on the following laws and regulations issued by the concerned Government authorities:

- Constitution of the Republic of Cuba (Articles 27 and 49)
- Environmental Law No. 81, 1997
- Resolution 77/99 on Investment Process
- Ministerial Resolution 87/99 on Hazardous Waste
- Resolution 42/99 on the Classification of Biological Agents by Risk Groups
- Decree 142 Regulating the Handling of Radioactive Substances and Other Ionizing Radiation Sources
- Decree 137 Regulating Safe Transport of Radioactive Substances
- Public Health Act 41/83 on State Sanitary Inspections
- Decree 54/82, Basic Sanitary Provisions

In addition, the National Institute for Hygiene, Epidemiology and Microbiology issued the “Manual for Hazardous Medical Waste Management” in 1998. This regulation defines the methodology for the operation and treatment of hazardous waste generated in hospitals.

(3) Definition of waste

There is no clear definition for classifying the waste generated in hospitals in Cuba. Based on the simplified classification of the World Health Organization (WHO), wastes generated in hospitals are classified into three different types, 1) non-hazardous general waste, 2) sharp-cutting objects (infected or not), and 3) infectious waste (except infected sharp-cutting objects). In addition, there are also expired medicines, which are a type of medical waste, although their amount is small.

(4) Quantity of medical waste

According to CITMA, the amount of waste generated in the hospitals in Havana City was 22 tons/day. This figure included both hazardous and non-hazardous medical waste. On the other hand, based on data provided by the DPSC/UPPH, the daily volume and weight of medical waste collected and hauled to landfill by Aurora or UPPH is 15.1 tons/day (Table 3.10.2). This amount of waste included both hazardous and non-hazardous medical waste. It could be regarded that the

difference between 22 tons/day-generated waste and 15 tons/day-hauled waste was the portion self-disposed by hospitals, including the amount incinerated.

Although MINSAP regulations are for hazardous waste generated in hospitals to be treated separately from non hazardous waste, it was observed that some unsafe wastes such as hypodermic syringes were disposed of at landfills.

Table 3.10.2 Medical Waste Hauled to Landfill

Municipality	No. of Hospitals	Waste Volume* (m ³ /day)	Waste Weight* (kg/day)	Waste per Bed (kg/bed)
Playa	5	2.8	467	0.72
Plaza	12	18.0	3,000	0.72
Centro Habana	2	4.3	717	0.57
Habana del Este	2	6.8	1,133	1.24
Guanabacoa	1	0.8	133	1.00
San Miguel del Padron	1	1.5	250	1.00
Diez de Octubre	5	5.8	967	0.51
Cerro	5	9.6	1,600	0.66
Marianao	5	5.6	933	0.48
La Lisa	2	5.6	933	0.46
Boyeros	8	21.8	3,633	0.57
Arroyo Naranjo	7	7.5	1,250	0.63
Cotorro	1	0.5	83	0.42
Total	56	90.6	15,099	-

Source: DPSC/UPPH

Note: *: The figures represent the quantity of waste transported by Aurora or UPPH. This waste includes both hazardous and non-hazardous waste generated in hospitals.

(5) Current medical waste management

Observation during the Study has revealed that some medical wastes (e.g. used syringes, glass bottles of medicine, etc.) were disposed at landfills mixed with ordinary MSW. This may result in considerable health risk, especially to the workers engaged in the collection and disposal of MSW. It could be said that appropriate separation of hazardous medical waste has not taken hold in Havana City. Solid waste generated in hospitals including non-hazardous waste and some hazardous waste is treated as medical waste in the City.

As mentioned above, hazardous medical waste such as isolated organs generated in the hospitals equipped with an incinerator are treated by burning in incinerators. After burning at the hospital, residue is collected and disposed of at Calle 100, Guanabacoa or other landfills. In hospitals not equipped with incineration facilities, the generated hazardous waste is contained in nylon bags and transported by the Central Division of Public Health to other hospitals that have incinerators.

The UPPH and Aurora provide collection services for medical waste kept in waste bins (770 liter) by hospitals. Collected solid waste generated in hospitals is transported to a landfill by specially designated compactor trucks.

Figure 3.10.2 shows the flow of waste generated in hospitals.

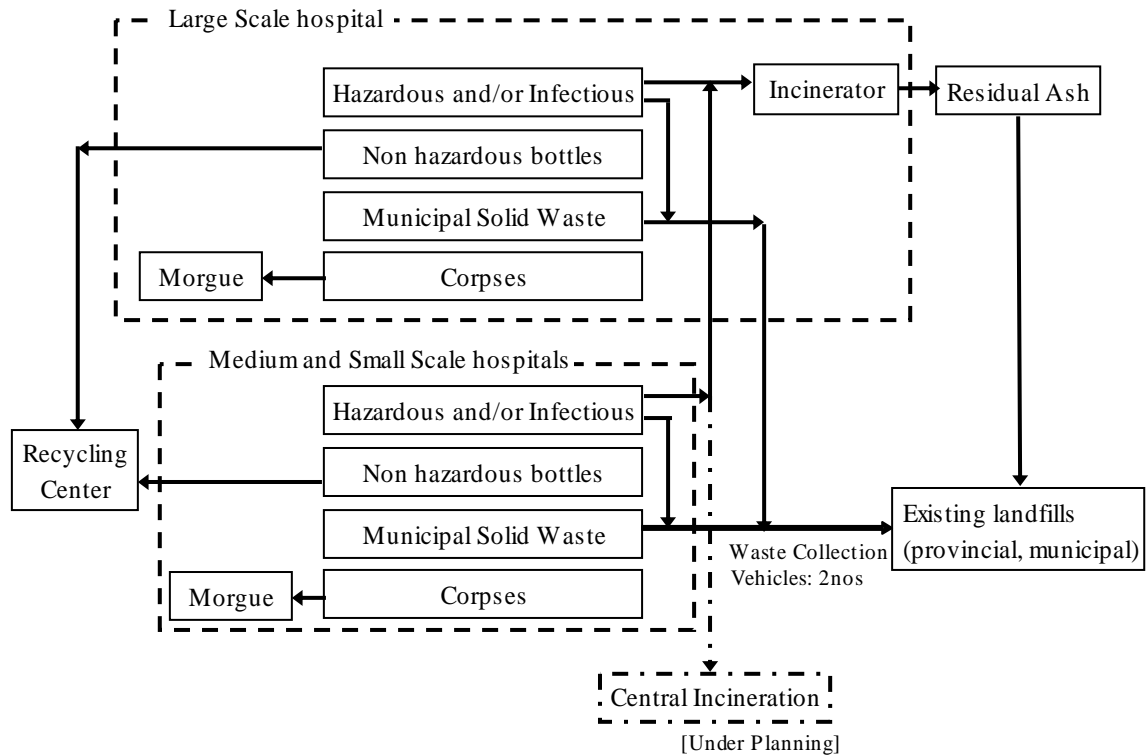


Figure 3.10.2 Flow of Waste Generation in Hospital

CHAPTER 4 NEED FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT IN HAVANA CITY

4.1 Organization and Legal Frameworks

4.1.1 Organizational Aspects

(1) Present organizational set-up

Figure 4.1.1 below shows the main organization of the government in Cuba and the City of Havana province in relation to solid waste management and how the individual institutions in charge of the operational and control tasks are placed in the government structure:

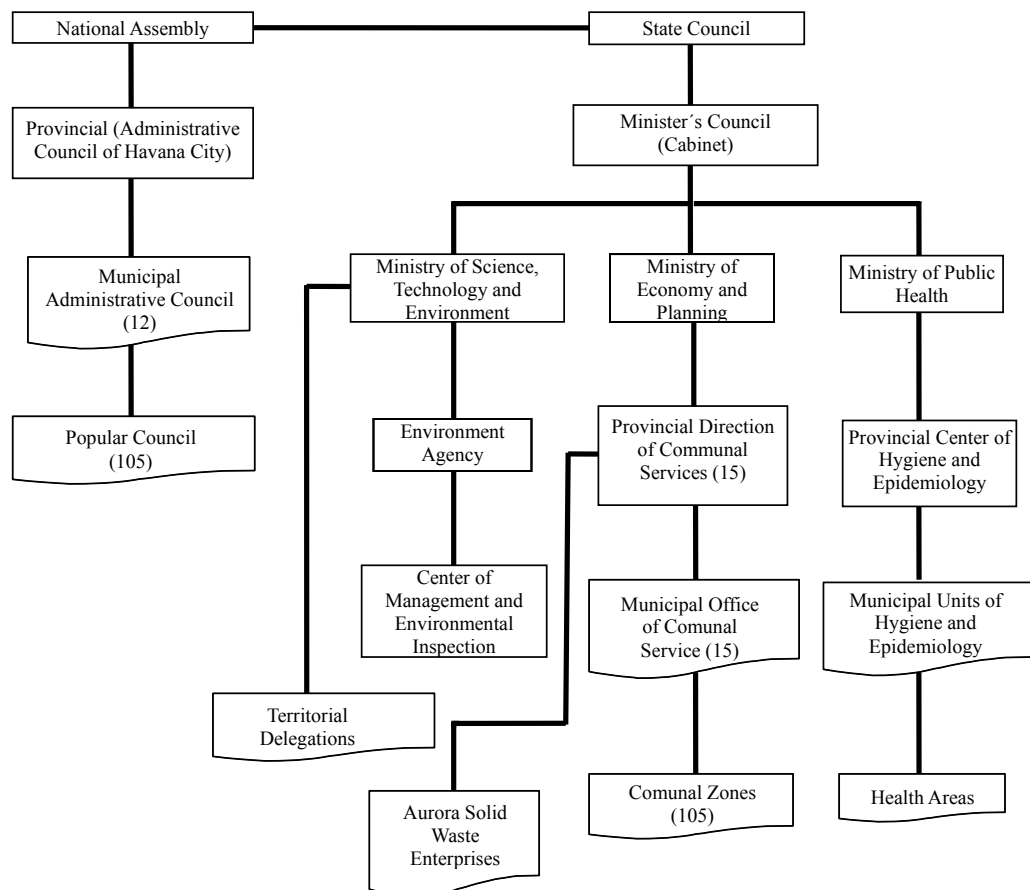


Figure 4.1.1 Structure of Government in Cuba and Havana City concerning MWSM

The solid waste management system of Havana City is based on an administrative and hierarchical structure where the different levels of municipal, provincial, and national government participate through the “double subordination” government system used in Cuba whereby government has two functions, one being

administrative and operational and the other “methodological”, which means setting guidelines for the operational aspects and the budget.

This administrative and institutional system is quite complex. Functions of operation and control are not separated, operation of collection and disposal of solid waste is shared among different institutions at different levels of government, depending on the type of waste and on the type of equipment used, and decisions are dependent on several ranks of officials from different institutions.

The DPSC belongs to the provincial government and is responsible, through UPPH, for solid waste collection using compactor trucks, which is prevalent in seven municipalities, while in several municipalities there are also DMSCs, which are responsible for collection using tractor-driven carts or horse-driven carts.

Responsibility for solid waste disposal is also shared between the Province (DPSC) and the Municipalities. The Provincial government is responsible for the larger disposal sites, the municipalities are responsible for the “special period” disposal sites still in use.

(2) Setting-up of Aurora Enterprise

An attempt to divide the functions of operation and control has been made in the setting up of the Aurora type institution in Plaza and Habana Vieja municipalities; in these two places, the semi-autonomous Auroras provide the operational services, and the municipal governments control the conduct of the services. So far, the operation of Aurora enterprises has provided some successful results. Plans for further expansion of Aurora activities would be worthwhile.

Administrators of modern solid waste management systems need to have a reasonable degree of autonomy to manage their resources and an adequate budget to meet operational needs. However, this does not happen in Havana where the budget is controlled at the central government level by the Ministry of Finance and Planning.

Expanded Aurora would attempt to operate as a more independent and financially sustainable institution that could replace the usual government administration institutions.

(3) Strengthening the capability of DPSC and CITMA

Other prevailing conditions, problems, and counter measures within the solid waste management system in Havana are:

- a) Planning capacity of DPSC - The planning capacity of DPSC is very limited not only because of a lack of human or material resources, but also due to the complex institutional system, where different levels of government and institutions are involved. DPSC shall have positively a leading role of planning the on-site operation of MSWM and convince higher authorities the need of its implementation with adequate budget.
- b) Environmental control by CITMA - Routine environmental monitoring is not regularly carried out at disposal sites because of a lack of resources such as equipment, vehicles and even consumables. Further, the CITMA staff, although very well educated, is not trained in key aspects of solid waste management, especially concerning the disposal of solid waste. Resources for better monitoring will be given to CITMA, such as equipment and vehicles as well as training the staff for performing its duties.

(4) Need for staff training

Cuban officials are technically very well educated, most of them holding university degrees in engineering, chemistry, architecture, etc. However, there is a lack of specific training in solid waste management, especially on:

- Planning and design of solid waste management operations (collection and street sweeping)
- Planning and design of solid waste disposal (sanitary landfill)
- Planning and design of solid waste treatment (recycling and composting)
- Control and monitoring of solid waste management routine operations

4.1.2 Legal Framework and Enforcement

(1) Need to establish a new set of MSWM regulations

In both legislation codes related to cleanliness of the City; that is, “Offences for City Cleanliness” and the Resolution No. 16/94. “Regulation of Hygiene and Beautification for the Havana City”, the portions relating to public cleanliness represent only a small part, while most of the codes are concerned with issues, such as parks and gardens maintenance, cemeteries, use of public spaces, etc.

Some of the regulations and ordinances have been enforced by the inspector corps of DPSC; however, the behavior of citizens concerning the city’s cleanliness is still uncooperative. The main reason for that is because the ordinances and regulations related to solid waste management are scattered among several documents and are not clear, and therefore this makes enforcement difficult.

In order to contribute to the development of a single solid waste code that will better define offenses relating to cleanliness of the City and also direct the citizen's to cooperate with the efforts to make Havana City a more beautiful and organized space, a proposal for a new Solid Waste Management Regulations of Havana City Province is presented in Supporting Report E.

(2) Need for establishing a set of regulations for landfills

Regulations related to the safe and sanitary disposal of solid waste in sanitary landfills are also scattered among many environmental codes and pieces of legislation.

Concerning sanitary landfills in particular, the existing norm as well as several other codes and ordinances related to this subject do not reflect recent advancements in the technology for constructing and operating sanitary landfills.

A proposal for improving the present regulations on sanitary disposal of solid waste is presented in Supporting Report E as a draft "Regulations and Guidelines for Sanitary Landfill Construction and Operation".

4.1.3 Inadequate Operation and Maintenance Structure

Vehicles and heavy equipment to be serviced are very diverse because the City government has not been able to standardize its fleet. The existence of several different types of equipment without standardization creates special difficulty in the operation and maintenance of the machinery. Accordingly, the divisions and subdivisions of the operational units, at provincial and municipal levels, also make it more difficult for DPSC and DMSC to concentrate their scarce resources for operation and maintenance.

4.2 Financing Aspects

4.2.1 Tight Government Budgets

The financing for expenditure on the MSWM of Havana City is summarized in Table 4.2.1.

A total of 89% of the CUP portion and 12% of the CUC portion of expenditures for MSWM were financed by Government funds. Overall, the Government financed 88 percent of the MSWM expenditures.

It seems that the Government financing position is already stringent and hence further increase in Government support might be somewhat difficult. In this

context, the feasibility of cost recovery from tariff revenues was examined and is described in succeeding sections.

The exception is the budget for capital-intensive projects, for which the State Government financing is still needed in view of the financial capability of the City Government.

Table 4.2.1 Financial Balance of MSWM in Havana City (2003)

	CUP portion** (million pesos)	CUC portion** (million pesos)	Total (million pesos)
Expenditure	156.9	2.0	158.9
Revenue from User charges	17.7*	1.8	19.5
Financing from the City Government fund	139.2	0.2	139.4
Dependence on City Government financing	89%	12%	88%

Note: * Nominal total fee revenue was 28.3 million pesos, but a part of it, 10.6 million pesos, was paid by the City Government as a subsidy to cover the amount that should have been paid by the citizens. Thus, the amount of actual fee revenue income was interpreted as 17.7 million pesos. The 10.6 million pesos was included in the financing from the City Government. The revenue is presently income to the City Government and therefore constitutes a part of the City Government budget.

** CUP: Cuban local peso, CUC: Cuban convertible peso

Source: DPSC and estimation by the Study Team

4.2.2 Need of Tariff Review

Another source of finance for the MSW operating agencies may be revenue from tariffs for MSWM services. The present regulations set forth the tariffs for waste collection services as shown in Table 4.2.2. However, residents are not actually charged any tariffs. Instead, the municipal government funds are transferred to the Aurora companies instead of payment from the residents.

Table 4.2.2 The Present Rates of Tariffs in 2005 for Solid Waste Collection in Havana City

Collection type Customer type	Curbside collection	Collection by exclusive bin
Household	CUP0.4/person/month *	Not applicable
Cuban institutions without CUC earning	CUP2.1/account/day	CUP3.8/bin/day
Cuban institutions with CUC earning	(CUP1.1 + CUC1) /account/day	(CUP2.3 + CUC1.5)/bin/day
Foreigners and tourists	CUC1/account/day	CUC4/bin/day

Note: * Although the tariff is set, tariff for households is not charged and actual payment is made by the municipal governments as stated in the text.

Another issue is that because MSWM tariffs have not been reviewed since 2001, the current tariffs do not properly reflect the actual costs.

Besides the collection tariffs stated above, a nominal fee is set for tipping of waste at landfills at a rate of CUP0.5/ton. However, that tipping fee is not actually collected and is covered by Government subsidy.

At present, both the CITMA and DPSC are of the opinion that no tariff will be charged to residents for the foreseeable future in line with the Government policy. This tariff issue will be studied further in the formulation of the M/P.

4.2.3 Potential for Cost Reductions

It is always common for governments to economize its budget while the level of public services will be maintained at the acceptable level. For this purpose in the field of solid waste management, for example, reduction of municipal staffs by the reduction of waste collection frequency or usage of cheaper equipment and tools is experienced in many cities in the world.

However, considering the economic circumstances in Cuba, it can be said that such potential for cost reduction is almost impossible for Havana city. Havana city has already expended as much effort as possible for cost reduction. There was no other choice for Havana City than to develop the SPLs near the waste generation sources in order to reduce the waste collection and transportation costs even though it was understood at the time of establishment that the environmental measures for the SPLs were not appropriate. Based on the government policy of not charging any tariff to the residents, the government has to budget for this tariff subsidy in addition to the normal expenditure on SWM activities conducted under the current critical economic circumstances. Considering this, there is no surplus for the government to reduce those costs.

4.3 Recycling

4.3.1 Need for Introducing Segregated Discharged of Waste

While the UERMP collects recyclable material mainly from industries, it is deemed that there is still some potential for recovery of material from domestic waste. In the management of domestic solid waste in Havana City, sufficient attention has not been paid to the material recovery by DPSC. Although the DPSC is operating a recycling center that picks up recyclable materials, its function has not been fully attained due to the absence of proper segregation of wastes.

In general, the lack of waste segregation at source and its collection hinders the efficient utilization of recyclable materials transported to the recycling center. If recyclable materials in MSW arrived at the center without mixing with other

substances, they could be suitable to be segregated by materials. Picking recyclable materials out of mixed waste containing non-recyclable materials is so tough and unhygienic that workers may be reluctant to do.

Introduction of segregated discharge and collection of recyclable waste is the primary requirement.

4.3.2 Facilities for Efficient Material Recovery

The existing recycling center located close to Calle 100 landfill does not function as planned. At present, the center is equipped with several pieces of equipment, such as a belt conveyor and pressing machine, but most of them are out of order.

To improve the recovery of recyclable materials from MSW, provision of adequate equipment is required for the plant.

4.3.3 Incentive for Recyclable Material Recovery

All recyclable materials recovered in Havana City shall be sold to a pre-established system where the trading price is controlled by the UERMP. At present, DPSC is not authorized to sell the recuperated recyclable materials on the free price market.

If the development of a free price market is allowed for DPSC, it may encourage DPSC or Auroras to launch further promotion of their recycling business.

4.4. Composting

4.4.1 Need for Segregated Collection of Organic Waste

The organic material occupies a large portion of MSW. The reduction of organic waste by utilization for other purposes could contribute to the extension of the service life of landfills and decrease the workload for MSWM. A possible way of using organic waste is in composting.

In municipalities in semi-urban areas, a considerable area is used for agriculture and plantation. In such areas, segregated organic materials can be utilized as raw material for composting to use for agriculture and plantations as soil conditioners. But, no notable attempt to encourage people to use organic matters for this purpose has been provided because the utilization of organic waste and its effect on waste reduction had not been highlighted intensively in the past.

In order to obtain raw material for composting in better condition through the waste collection, the segregation of organic waste should be practiced at the waste generation source. This is another reason for emphasizing the need for segregated collection of waste.

4.4.2 Need for Proper Facilities for Composting

At the existing provincial landfill, piles of organic materials can be seen. However, the condition of fermentation and other processes in these composting operations are not controlled at all. Therefore, most of the compost produced at the landfills cannot satisfy the quality requirements for agricultural use; only the humus produced and earthworm compost made from animal manure are presently usable.

To produce composts of acceptable quality, proper control of fermentation and other processing is essential. This could be achieved only if proper composting facilities are installed together with the supply of necessary equipment.

4.5 Collection and Transportation

4.5.1 Shortage of Vehicle in UPPH Service Area

The UPPH collection service covers the central part of the City everyday. Bins are placed on major roads and in inner areas accessible to C/Ts. However, sometimes the services cannot cover the surrounding area because of the shortage of vehicles. On the other hand, DMSC covers semi urban areas everyday relatively sufficiently.

There is apparently a need for reinforcing the number of collection vehicles particularly in UPPH service areas.

4.5.2 Replacement of HDPE Bins with Steel Bins

UPPH collection service is carried out using C/T vehicles and HDPE (High Density Polyethylene) bins. The capacity of the bins ranges from 770 to 1,100 liters, and the bins are equipped with a lid, wheels and lifting lugs. About 12,000 units are installed on sidewalks, but 700 bins need to be replaced annually because of their disappearance or damage.

Small numbers of metal bins were introduced in some areas several years ago, and UPPH wanted to replace the HDPE bins with steel bins, though it is a little costly,

because the steel bins could be easily repaired at their workshops. Replacement of the type of bins may be worthy of consideration.

4.5.3 Collection Vehicles used in DMSC Service Area

DMSC collection service uses collection vehicles of conventional type, such as D/C, T/C and H/C. The Study has revealed that the performance capacity of these vehicles is less than that of C/Ts. Although over 58% of the total number of vehicles are H/Cs, they collect only 9% of total MSW.

The type of vehicles to be used in the future was studied in the M/P.

4.5.4 Awareness-raising to Gain Residents' Cooperation in Waste Discharge

Much garbage is left scattered on the roads near collection stations, so collection crews are required to do additional collection work. If the residents recognize the need for proper MSWM and cooperate with the collection services, the conditions surrounding the bin stations will be considerably improved.

The need for awareness-raising and education of the residents is emphasized.

4.6 Final Disposal

4.6.1 Sanitary and Environment-Friendly Landfill

The existing landfills, including provincial landfills, are not recognized as sanitary or environment-friendly because those are not provided with a liner system, leachate collection and treatment facilities, or gas vents, and further, no waste covering with soil is practiced at present.

Daily waste covering with soil, which is a fundamental requirement of operating a sanitary landfill, is at a far from acceptable level, even in provincial landfills. Insufficient cover soil is causing health and hygiene problems such as dust, odor and outbreaks of mosquitoes and flies, frequent spontaneous combustion, and scattering of plastic bags in the neighboring lands.

The lack of a liner system and leachate collection/treatment facilities also presents potential threat to the quality of groundwater and surface water in the surrounding area. The results of the water quality survey undertaken during the Study suggest that untreated leachate is polluting the surrounding water bodies.

Periodic monitoring of the quantity and quality of leachate, quality of groundwater and public water bodies, generated gas composition, odor and so on is also important in landfill operation and management, but is not being done.

The M/P shall include plans for rectification of this situation in the future.

4.6.2 Landfill Management

Present landfill operations contain the following problems, for which corrective measures are proposed in the M/P:

(1) Planning of landfills

Guanabacoa and three of the special period landfills have already been closed and another six special period landfills are to be closed within a few years following the City's direction. However, this decision was made without a clear vision for alternative landfills. For example, the waste to have been hauled to the former Guanabacoa is planned to be hauled to Ocho Vias industrial landfill and Campo Florido, both of which are too small to accommodate the waste for a long period.

(2) Shortage of landfill equipment

The number of equipment available for landfill operation is limited. With the small number of landfill equipment, it is hard to undertake waste compaction and daily soil covering at all existing landfills. At present, UPPH has five fairly old bulldozers (two are owned and three are rented) including one for Ocho Vias. At the special period landfills managed by DMSC, rented or donated equipment is used. In addition, no truck scales are available, although the DPSC recognizes the necessity of installing them.

(3) Need for training personnel

There are very few personnel with knowledge and experience in the planning of waste management operations, planning and design of sanitary and environmentally friendly landfill facilities, and planning of monitoring systems.

4.7 Maintenance Workshop

4.7.1 Rules of Checking Mechanical Performance

UPPH does not have a guideline specifying the rules of vehicle renewal, but it has practical rules as follows: i) new vehicle shall have a minimum use life of 9 to 10 years, and ii) old vehicles have to be reconditioned as much as possible by using parts transferred from other disabled vehicles. However, there are no rules regarding the standards to check mechanical performance such as emission control, mileage, air compression, and power.

Most of the vehicles owned by UPPH and DMSC have been used for a period of 10 to 20 years and even longer. From the viewpoint of ensuring the reliability and efficiency of the vehicles, UPPH and DMSC have to prepare a guideline that describes the details of checking the condition of vehicles and rules and schedules for overhaul and maintenance.

4.7.2 Spare Parts and Maintenance Equipment

The number of vehicles in workable condition is limited; only 63% of all vehicles were in workable condition in 2004. The major reason for this is that over 53% of the operating vehicles were manufactured before 1995. UPPH and DMSC have not been able to purchase spare parts for the last 4 years. As a result, there is virtually no stock in the workshops at present. Therefore, if vehicles need parts for repair, the maintenance division must place an order to each particular overseas manufacturer every time.

The workshops are equipped with only a limited range of maintenance equipment. For conducting proper repair and maintenance, there is a minimum range and quantity of repair and maintenance equipment and tools that must be available and kept in good operating condition.

4.7.3 Procedure of Procurement of Equipment and Spare Parts

Procurement of equipment and spare parts from overseas manufacturers takes a very long time. When the UPPH and DMSC need to purchase equipment and/or spare parts, they have to obtain a purchase approval from the CAP through DPSC. It usually takes three to six months.

4.8 Awareness-raising and Citizen Participation

4.8.1 Need for Awareness-raising Programs

The Cuban Government gives a very high priority to the public education. A comprehensive structure is in place for all types of awareness-raising and environmental education activities. Also the social organizations at community level, such as the delegates of the “*circunscripciones*” (neighborhood) and CDR, greatly facilitate efforts in reaching the population and obtaining their participation.

However, many people continue to litter public spaces with waste. This implies that the current efforts are still not sufficient. Even though many are aware of the need to keep the city clean, there is still social indiscipline and neglect by

people and poor enforcement of the law. This shows that the existing system, although well organized on paper, has not obtained the desired results.

More intense effort is needed to attain the desired level of awareness-raising and education of people.

4.8.2 Coordination between DPSC and EPEA Coordinating Entities

The Provincial Government set forth a provincial strategy for environmental education (EPEA). The EPEA is a strategy that contemplates environmental education in general, with some aspects dealing with solid waste. However, the links between DPSC and EPEA coordinating entities are rather weak, or they do not contribute sufficiently to a structural solution to the problems. The required actions are planned but not taken mutually, or potential created is not fully utilized. Although DPSC formally utilise staff responsible for contact with the public for awareness-raising and environmental education, these staff seem to be under-utilised at present.

Also, there is no central point to file the complaints regarding waste at present. This makes it more difficult for the population to request actions to be taken or report problems to be solved. Provision of such a contact point, with standardized procedures, would be highly desirable.

4.9 Social and Environmental Aspects

4.9.1 Identification and Dissemination of Problems

UPPH and DMSC shall endeavor to identify the ongoing and potential problems regarding MSWM and disseminate the findings to the people as one of the programs for awareness-raising and education. It is expected that knowledge of such problems would certainly encourage people to participate in MSWM activities.

At present, provision of quantitative information seems to be insufficient. It is proposed that a monitoring system be established to keep record of some basic indicators. These indicators would include, for example, the percentage of litter inadequately disposed by the population, the number and location of problematic areas, and so on.

The major environmental problems related to MSWM at present are summarized below. All are regarded as presenting a hazard to people's health and livelihood.

- 1) Littering of waste everywhere in the City due to insufficient alignment of trash boxes/waste bins and illegal dumping of waste
- 2) Overflow of waste from waste bins due to irregular collection of waste
- 3) Environmental problems around landfill sites from scattering of waste, noxious odor, breeding of insects, spontaneous combustion, and degradation of water quality in surface and underground water bodies
- 4) Air pollution due to exhaust gases from the old vehicles used for waste collection
- 5) Potential hazard to the public and especially workers engaged in MSW collection and disposal due to the discharge of industrial and medical hazardous waste mixed in MSW

4.9.2 Intensification of Social Studies

Environmental and social issues must be examined in EIA, which is required to obtain permission for development of any activity that has the potential to impact on the environment and/or population.

A compulsory requirement in EIA is to organize a public hearing during its preparation, the results of which have to be considered and the problems addressed in the final EIA report. At present, however, this requirements is not well implemented. Officials from CITMA have indicated that they will start to improve the enforcement of the public hearing requirements of EIA, but for the time being this important legal tool seems to be underutilised.

Many deficiencies can still be identified in the process of EIA; for example technical teams responsible for the elaboration of the EIA are usually made up exclusively of professionals from technical fields with social experts rarely included. This is an indication of the extent to which social impacts have been neglected.

In this regard, it is advisable that technical teams conducting environmental impact studies include a social expert, and that sufficient attention be given to the public hearings to look into social issues deeply. This is easy to achieve, since CITMA, being the responsible organisation on behalf of the government can simply demand it as a pre-condition for the issuance of a licence for the activity.